Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #001

Reference:

Exhibit A Tab 5 Schedule 2

Interrogatory:

Preamble: The corporate governance framework consists of the Board of Directors and its committees, an independent internal auditor, a Chief Compliance Officer, policies and procedures and Bill 198 controls.

a) Please summarize the types of internal reports prepared by Hydro One's internal auditors.

b) Please provide a listing of all 2015 and 2016 reports prepared by Hydro One's internal auditors relevant to this application.

c) Please summarize the key recommendations from Hydro One's internal auditors that have been incorporated in the current application.

d) Please provide the internal audit plans for 2015 to 2018.

Response:

a) Guided by an annual risk-based Internal Audit work plan, Internal Audit performs compliance, assurance and advisory audits/reviews in the Financial and Operational, Environment, Health and Safety, Information Technology, Technical, and Construction/Capital Projects areas of the organization, and provides to the Board of Directors and management:
   - assurance regarding the quality of internal controls for high risk operating processes;
   - periodic assurance that the status of management's corrective actions are appropriate; and
   - advice to achieve greater efficiency and effectiveness of operations.

b) A list of relevant 2015 and 2016 audit reports is included as Attachment 1.

c) A summary of key recommendations is included as Attachment 2. A column has been added to provide the status of management's actions to address the recommendations. Content pertaining to IT and cybersecurity has been redacted for security purposes.

Witness: Michael Vels

d) The internal audit plan for 2015 is included as Attachment 3, and the internal audit plan for 2016 and 2017 is included as Attachment 4. The internal audit plan for 2018 has not been completed yet as Internal Audit is presently transitioning its planning process to a rolling three-year audit plan which still needs to be endorsed by Hydro One's executive management and approved by the Audit Committee of the Board of Directors. Each year's audit plan is subject to change based on an annual update process as well as emerging risks and requests from the Board of Directors and senior management.

Audit Reports Issued in 2015	
Report Number	**Audit Name**
2014-15	Shared Services Accommodation and Facilities Management Work Process Inspections
2014-16	Provincial Lines Utility Work Protection Code
2014-17	Shared Services Fleet Services Work Process Inspections
2014-18	Shared Services Logistics Work Process Inspections
2014-19	Provincial Lines Work Process Inspections
2014-20	Ontario Grid Control Centre IT Documentation Review
2014-23	Station Services Work Process Inspections
2014-29	Investment Planning
2014-30	Hydro One Networks Inc. Driver Safety
2014-31	Hydro One Networks Inc. Fleet Environmental Impacts
2014-32	HR Cloud Computing Security Reviews
2014-33	Large Customer Client Services
2014-34	Large Customer Connection and Cost Recovery Agreement True - Up
2015-01	2014 Corporate Scorecard Phase 2
2015-03	Central Maintenance Services Finance and Operations Controls
2015-05	Hydro One Networks Inc. Asset Deployment
2015-06	Project Management Control on the Network Management System Upgrade Project
2015-07	Construction Services Job Safety Planning and Work Safety Observations
2015-08	Information Solutions Division Major Project Processes and Controls
2015-09	NERC CIP V5 Project
2015-10	2015 Corporate Scorecard - Phase1
2015-11	Conservation and Demand Management
2015-12	Treasury Operations
2015-13	Corporate Technical Standards
2015-16	NERC CIP V5 Project Management - Follow Up
2015-17	Tx Protection and Control
2015-18	Clarington Project - Review of Project Management
2015-19	Spill Management
2015-20	Interim Review or Variances

Audit Reports Issued in 2016	
Report Number	**Audit Name**
2015-24	Hydro One Networks Inc. Below Grade Construction Activities
2015-25	Transmission Outage Management
2015-27	Provincial Lines Job Safety Planning Audit
2015-28	Station Services Job Safety Planning Audit
2015-30	Disaster Recovery Review Report
2015-31	2015 Corporate Scorecard Phase 2
2015-32	Construction Project Mgt Processes
2015-33	Preventative Maintenance Optimization TxLines
2015-35	Inergi Services IT Contract Management
2015-36	Safety Incident Investigation Follow Up
2015-37	Hydro One Networks Inc. Utility Work Protection Code Governance

SUMMARIES OF INTERNAL AUDIT REPORTS OF OM&A AND CAPITAL EXPENDITURES

Included in this Exhibit are Action Items pertaining to 2014 and 2015 Audit Reports.

Note: Risk Levels – Definitions

	DEFINITION
H	= High – Controls are Ineffective or need significant improvement.
M	= Medium – Controls Need Some Improvement
L	= Low – Controls are Good

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
Audit of Shared Services Accommodation and Facilities Management #2014-15 January 14, 2015	**1.0 Job Safety Planning**			
	Re-implement the Job Safety Planning for Facilities field-based staff that will clarify Facilities expectations for satisfying the requirements of SP0282 Health, Safety and Environment Annual, Periodic and Job Planning Risk Assessments by: (a) Reviewing the Job Planning Folder with Facility Manager(s), (b) Conducting a quarterly review of the folder, and (c) Verifying conformance through WPIs.	(a) The existing Facilities Job Planning Folder for Facility co-ordinators will be reviewed with Facility co-ordinators by the Facility Manager and signed off by the Facility Co-ordinators at the next team meeting slated for Dec 2014 and Affected Facilities Managers will be asked to take available HOLMS JPF training, if required. (b) Thereafter it will be reviewed monthly by the Facility Co-ordinator in the field and signed off and at quarterly staff meetings with the supervisor and signed off after a discussion. (c) For a period of 6 months beginning in Jan 2015, thru required monthly WPI's, the Facilities Manager will verify for applicable staff the completion of the monthly Job Safety Planning folder (JSPF) sign off and will in discussion with staff at quarterly team meetings re-affirm the importance of the JSPF.		**COMPLETE** – Q2, 2015
Audit of Provincial Lines – Utility Work Protection Code #2014-16 January 14, 2015	**2.0 Monthly Utility Work Protection Code Audit**			
	(a) Develop and document and implement a standard process for the monthly UWPC audit to ensure that they are consistently being	A new monthly UWPC assessment form has been developed and is currently awaiting approval at the CAG. The form has assessment expectations which take into consideration all the		**COMPLETE** – Q1, 2015

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	carried out in an effective way. The process should include a standard practice for; • Identification, review and tracking of corrective action items • Cross referencing tags and permits with the DOMC log • Filing of tags and Permits • Frequency of audits • Reporting UWPC audit findings to the Zone Superintendent (b) Implement the monthly UWPC process.	recommendations of the audit findings. Signatures for review have also been added to form.		**COMPLETE** – Q1, 2015
Audit of Provincial Lines – Utility Work Protection Code #2014-16 January 14, 2015	**2.1 Project Crew Monthly UWPC Audit**			
	Include a standard practice for the review of Project Crew UWPC tags and permits in the monthly UWPC audit process	Project Crews will complete their own audit and assessment expectations. The audit will then be sent to the area location where the UWPC took place. The location auditor will check to ensure all UWPC protection is accounted for. The project and area work protection will be filed along with the audit and DOMC log.	M	**COMPLETE** – Q1, 2015
Audit of Shared Services – Fleet Services Work Process Inspection Audit	**1.0 Job Safety Planning Services**			
	(a) Develop and document a Job Safety Planning Procedure for Fleet Services that satisfies all the	(a) HODS SP1604 for Fleet Maintenance Job Planning is now in place. (b) A review of the Fleet Maintenance	M	(a) **COMPLETE** – Q1, 2015 (b) **COMPLETE** – Q4, 2015

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
#2014-17 January 14, 2015	requirements of *SP0282 Health, Safety and Environment Annual, Periodic and Job Planning Risk Assessments.* (b) Implement the revised Job Safety Planning process in the Fleet Services organization.	Job Planning document is now underway and shall be delivered to those being trained.		
Audit of Shared Services – Fleet Services Work Process Inspection Audit #2014-17 January 14, 2015	**2.0 Work Process Inspection of Trouble Calls and Field Assignments**			
	Include direction in the new Fleet Services WPI directive documents to ensure that a representative sample of field-related operations and assignments are included in the WPI process.	WSO/WPI process in Fleet Services will include field visits as a requirement for the FLM at the rate of 1 per quarter in both Fleet Maintenance and Helicopter Services.	M	**COMPLETE** – Q1, 2015
Audit of Shared Services – Fleet Services Work Process Inspection Audit #2014-17 January 14, 2015	**3.0 Quality of Work Process Inspections**			
	3.1 Reinforce the expectation with supervisors and managers that their crews conform to the requirements for documented, daily Job Safety Planning (see 1.0 above). 3.2 Reinforce the expectation with supervisors and managers that WPIs need to be thorough enough to verify conformance to safety requirements and identification of rule departures.	3.1 Helicopter Services will have a meeting to reinforce the expectation with supervisors and managers that WPI's need to be thorough enough to verify conformance to safety requirements as well as reinforce positive behaviours and correct the improper behaviours. 3.2 Helicopter Services will have a meeting to reinforce the expectation with supervisors and managers that WPI's need to be thorough enough to verify conformance to safety	M	3.1 **COMPLETE** – Q1, 2015 3.2 **COMPLETE** – Q1, 2015

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	3.4 Reinforce the expectation with managers and supervisors that WPIs need to involve significant and meaningful inspector/worker communication to promote safe work and to maximize coaching and mentoring opportunities. 3.5 Improve oversight, through the existing Quality WPIs, and adequate review of completed WPI Forms to ensure that they are being filled out correctly and include all improvement opportunities identified during the inspections.	requirements as well as reinforce positive behaviours and correct the improper behaviours – we have also built on the success of the Fleet WPI's and JP process and extended to Heli Group. 3.4 Fleet Director will reinforce the expectation with supervisors and managers that WPI's need to be thorough enough to verify conformance to safety requirements and identification of rule departures. 3.5 Review these requirements with all Fleet Maintenance Supervisors. Helicopter Services will have a meeting to reinforce the expectation with managers and supervisors that WPIs need to involve significant and meaningful inspector/worker communication to promote safe work and to maximize coaching and mentoring opportunities.		3.4 **COMPLETE** – Q4, 2014 3.5 **COMPLETE** – Q1, 2015
Audit of Shared Services – Logistics Work Process Inspection Audit #2014-18 January 14, 2015	**1.0 Job Safety Planning**			
	(a) Develop and document a Job Safety Planning Procedure for Logistics that satisfies all the requirements of *SP0282 Health, Safety and Environment Annual, Periodic and Job Planning Risk Assessments.*	(a) The current Supply Chain – Logistics Job Planning Folder will be amended to include a requirement for daily discussion and recording of job steps, hazards and barriers. (b) The Supply Chain – Logistics Job Planning Folder will be reviewed annually, signed and dated by the Manager of Logistics to verify its	M	**COMPLETE** – Q1, 2015

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	(b) Enter the Logistics Job Safety Planning procedure document into the HODS system or Head Office Group 1&2 Operational Plan to ensure that it is periodically reviewed and appropriately managed. (c) Revise the *Daily Tailboard Meeting Minutes* form to promote a safety discussion focussing on the job steps, hazards and barriers.	continuing applicability and adequacy. (c) Develop more robust tailboard documentation that acknowledges critical hazards with a severity assessment of 10 AND significant environmental aspects per SP0282		
Audit of Shared Services – Logistics Work Process Inspection Audit #2014-18 January 14, 2015	**2.0 Quality of Work Process Inspections**			
	2.2 Reinforce the expectation with supervisors and managers that WPIs need to focus on work being performed and intrusive enough to verify compliance to safety requirements.	2.2 Implement the new WSO process developed for Operational Plan – Head Office.		2.2 **COMPLETE** – Q1, 2015
	2.3 Reinforce the expectation with Logistics Managers and Supervisors that WPIs need to include observation of work in progress.	2.3 Implement the new WSO process developed for Operational Plan – Head Office		2.3 **COMPLETE** – Q1, 2015
	2.4 Reinforce the expectation with Logistics Managers and Supervisors that WPIs need to involve observation of work in progress with significant inspector/worker	2.4 Reinforce at the next leadership team meeting, the expectation that supervisors, when conducting WPIs that the primary focus is worker safety and that interaction with crew members is critical.		2.4 **COMPLETE** – Q1, 2015

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	communication to promote safe work and to maximize coaching and mentoring opportunities. 2.5 Improve oversight through Quality WPIs and review of completed WPI Forms to ensure that they are being filled out correctly and including all improvement opportunities identified in the inspections.	2.5 Reinforce at the next leadership team meeting, the expectation that supervisors, when conducting QWPIs and reviewing completed inspection forms must ensure that the completed forms reflect any issues identified in the inspection and that the completed forms are correctly filled out.		2.5 **COMPLETE** – Q1, 2015
Audit of Provincial Lines Work Process Inspection Audit #2014-19 December 14, 2015	**1.0 Job Safety Planning and Tailboard Conferences**			
	(a) Re-enforce the expectations for the use of the new Job Planning /Tailboard forms with all Provincial Lines staff. (b) Monitor fulfillment of the expectations for the use of the new forms for a sufficient period of time to achieve their consistent use. (c) Ensure continued appropriate use of the Job Planning and Crew Communication/Task form through Work Process Inspections.	(a) WSO process to be rolled out provincially by year end, Job planning committee meeting took place 2nd quarter 2014. Modifications and areas for improvement rolled out to field through a voice over power point presentation in December monthly communication package. (b) Select dedicated staff to monitor and coach field staff on the new WSO process beginning in January 2015. A schedule will be developed to satisfy the expectation to monitor each Area for a minimum of one week. (c) The 2015 annual Supt WPI schedule will be replaced by the WSO process and format: Zones will monitor throughout 2015 and		(a) **COMPLETE** – Q2, 2015 (b) **COMPLETE** – Q4, 2014 **COMPLETE** – Q2, 2015

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
		beyond, adherence to new process during regular crew visits.		
Audit of Provincial Lines Work Process Inspection Audit #2014-19 December 14, 2015	**2.0 Quality of Work Process Inspections**			
	2.1 Amend HO 3011 Work Process Inspections – Provincial Lines to make attendance at the Tailboard Conference a requirement for all WPIs until such time as the new job safety planning process is functioning effectively and then reduce the attendance requirement to a lower percentage.	2.1 Inspecting supervisors will attend the tailboard of the first scheduled visit of the day. Subsequent visits in the same day will ensure a thorough review of the tailboard documentation.	M	2.1 **COMPLETE** – Q2, 2015
	2.3 (a) Reinforce the expectation with supervisors and managers that WPIs need to be thorough enough to verify conformance to all safety requirements, re-enforce positive behaviours and correct improper behaviours.	2.3 (a) Expectation of completeness and thoroughness of WPI/WSO to be communicated to the Supt's by end of Q4 2014 for immediate implementation across the province.		2.3 (a) **COMPLETE** – Q2, 2015
	2.3 (b) Implement measures to enhance critical observation skills of field supervisors.	2.3 (b) Annual WSO visits to include dialogue from HS&E highlighting changes to the process and what their purpose is. Additionally, dedicated staff will conduct WSO and coach staff on expectations of new process including mandatory acknowledgement of pre-use equipment and PPE inspections.		2.3 (b) **COMPLETE** – Q2, 2015
	2.5 Improve oversight, through adequate	2.5 Monthly reviews to occur at Zone Leadership meetings and Provincial review of trends at the monthly Supt meeting.		2.5 **COMPLETE** – Q2, 2015

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	review of completed WPI Forms to ensure that they are being filled out correctly and include all improvement opportunities identified during the inspections.			
Audit of Provincial Lines Work Process Inspection Audit #2014-19 December 14, 2015	**3.0 Analysis and Trending of WPI Findings**			
	(a) Reinforce the expectation with all managers in Provincial Lines the expectation that all issues identified during WPIs are accurately and effectively captured on the WPI form and transferred to the Monthly Activity Report. (b) Implement a mechanism to collect the Zone summary information from WPIs for analysis and trending purposes at the LOB level.	(a) The monthly activity report will be implemented for trending purposes across Provincial Lines. (b) Zone monthly activity reports will be collated into one document and analysed for trends across the LOB and reviewed quarterly at Supt meetings. This document will be linked through a common SharePoint site for manager access throughout Provincial Lines.	M	(a) **COMPLETE** – Q4,2014 (b) **COMPLETE** - Q1, 2015
Ontario Grid Control Centre IT Documentation Review #2014-20 December 22, 2014	**1.0 NERC-CIP compliance efforts**			
	[redacted]	[redacted] This project has an in-service date of April 2016.	M	**COMPLETE** – Q2, 2016 [redacted]

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	[redacted]			
Ontario Grid Control Centre IT Documentation Review #2014-20 December 22, 2014	**2.0 Preparing Business Requirement documents for NMS**			
	[redacted]	[redacted]	M	**COMPLETE** – Q4, 2015 [redacted]
Ontario Grid Control Centre IT Documentation Review #2014-20 December 22, 2014	**4.0 SharePoint library ownership and administration**			
	[redacted]	[redacted]	M	**COMPLETE** – Q4, 2015 Upgrade Complete and staffing assignments made.

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	[redacted]			
Ontario Grid Control Centre IT Documentation Review #2014-20 December 22, 2014	**6.0 Security Shift Control Engineer documentation**			
	[redacted]	[redacted]	M	**COMPLETE** – Q4, 2015 [redacted]
Audit of Station Services Work Process Inspection Audit #2014-23 January 16, 2015	**1.0 Job Safety Planning and Tailboard Conferences**			
	(a) Amend SP 0095 R11 to clarify the expectations for the level of detail required in the development of job steps, hazards and barriers for job planning purposes and its role in the tailboard.	(a) Review and update SP 0095.	M	(a) **COMPLETE** – Q3, 2015
	(b) Clearly communicate the expectations for the development and use of job steps, hazards and barriers	(b) Communicate SP0095 revisions through Tri-Level meetings and also include in monthly safety meeting package for review.		(b) **COMPLETE** – Q3, 2015

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	with all supervisors and staff. (c) Ensure continued appropriate use of job steps, hazards and barriers in job planning and tailboards through Station Services QWPIs (WSOs moving forward) and WPIs.	(c) Continue to reinforce the expectations and monitor as part of the WSO process.		(c) COMPLETE – Q3, 2015
Audit of Station Services Work Process Inspection Audit #2014-23 January 16, 2015	**2.0 Quality of Work Process Inspections**			
	2.3 (a) Reinforce the expectation with supervisors and managers that WPIs need to be thorough enough to verify conformance to all safety requirements, re-enforce positive behaviours and correct improper behaviours.	2.3 (a) Develop and roll out safety meeting package.		2.3 (a) **COMPLETE** – Q2, 2015
	2.3 (b) Implement training measures to enhance critical observation skills of field supervisors e.g. role plays using real life scenarios.	2.3 (b) Approach Training & Development, HSE with goal to develop training package.		2.3 (b) **COMPLETE** – Q3, 2015
	2.5 Improve oversight, through adequate review of completed WPI Forms to ensure that they are being filled out correctly	2.5 Initiate quarterly documentation review process for stations.		2.5 **COMPLETE** – Q1, 2015

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	and include all improvement opportunities identified during the inspections.			
Audit of Investment Planning #2014-29 January 30, 2015	**1.0 Governance and Controls**			
	1.1 Perform a formal risk assessment as per ERM Policy (SP0736) on an annual basis to ensure that business risks facing the planning organization are identified and mitigating actions are developed and tracked.	Planning will work with ERM Group to conduct a risk workshop to identify risks in achieving the planning business objectives.	M	**COMPLETE** – Q4,2015
Audit of Investment Planning #2014-29 January 30, 2015	1.2 Develop, review and approve sufficiently detailed policies, standards, procedures and guidelines to ensure a consistent risk-based approach to planning and decision making. This would require a review of the existing governance documents and ARIS process models for their accuracy and validity. Management has informed us that a Policy Review project is currently underway to consolidate policy and directive documents.	Conduct a review of processes, procedures, standards and guidelines to determine the need, effectiveness, currency and to ensure they are aligned with and support the Corporate Operational Policies. Establish a review cycle for these documents.	H	**COMPLETE** – Q4,2015 Addressed: • In order to have effective policies, we have incorporated into the Operational Policy Program the need of a Communication and Implementation Plan for all New and Reviewed Policies. In the past, the Plan was only required for New policies. • Included the Communication and Implementation Plan as part of policy development and review rather than the Plan being delivered post policy approval. This is indicated in the policy program milestones. • Reviewed Cycle – We are now stating "reviewed date" and "next review date" in HODS and on the policies.

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
Audit of Investment Planning #2014-29 January 30, 2015	1.3 Clarify the timing and level of input to be sought by the planners from the service providers as they develop their plans. Define and communicate the required level of engagement with the service provider when investment plans are being developed to ensure that plans are based on asset needs rather than executability by the service providers.	At the annual LOB kick off, AM Processes and Tools will identify and seek input from the service providers to obtain their feedback on ideal timing and level of input required. Planning will also be in attendance to ensure agreement and consistency in approach.	M	**COMPLETE** – Q1, 2015
Audit of Investment Planning #2014-29 January 30, 2015	1.4 Implement a formalized Quality Assurance process and related performance measures to assess the effectiveness of the "end-to-end" planning process. This would include: • a Need identification and tracking process • guidelines on use and validation of AA data to assess needs and risks • QA reviews of Investment Summary Reports and feedback to planners • Supporting document availability and review, and • Realistic investment release dates.	Quality expectations and the required metrics for the end-to-end process will be established and communicated by the Planning Organization.	H	**COMPLETE** – Q4, 2015 End-to-end KPIs for the Investment Planning process have been developed and approved by the VP of Planning. Spreadsheet listing the KPIs is attached. Planning will received training on the KPIs through the Investment Planning Process training module.

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
Audit of Investment Planning #2014-29 January 30, 2015	1.5 Formalize and track all process and tool related training being given to planners in their Learning Management System. Establish refresher training requirements whenever there are significant changes in process and tools.	The Planning Organization will assess all training requirements including the frequency of refresher training and mechanism for tracking training completion. We will develop an implementation plan that defines the accountabilities for creation and delivery of training material.	M	**COMPLETE** – Q4, 2015 Investment Planning Training has been finalized and scheduled. Currently the list of individuals requiring training is being updated by Managers and once completed the lists will be loaded into HOLMS for tracking.
Audit of Investment Planning #2014-29 January 30, 2015	1.6 Document and communicate lessons learned after each planning cycle and use them for continuous improvement of the planning process.	AM Processes & Tools will document and communicate lessons learned after the 2016-2020 planning cycle.	M	**COMPLETE** – Q3, 2015 Survey results and action plan associated with opportunities for improvement have been posted to IM SharePoint site.
Audit of Investment Planning #2014-29 January 30, 2015	**2. Customer, Asset and System Need Assessment**			
	2.3 Request an audit of Asset Analytics data sources and algorithms to confirm that quality data and appropriate calculation methods are used for calculating the six Asset Risk Indexes for individual assets as well as asset groups.	SAP Data Audit on Asset and Maintenance data is already underway. The results of these audits will be used to address the underlying data issues in AA. Workshops with respective LOBs will be held regarding usability of existing algorithms.	H	On Schedule. Revised date of completion is Q4, 2016. Preliminary workshops have been setup for Tx AM Planners input into revisiting existing AA algorithms and adding new risk factors. Work continues into Q4 on this.
Audit of Investment Planning #2014-29	2.4 Consider expanding the scope of the Asset Analytics tool to include up-to-date power system historical	AM Process and Tools will request ISD to add audit recommendation to corporate application roadmap. Key requirement is to have access to NMS	M	**COMPLETE** – Q1, 2015

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
January 30, 2015	data such as load flows, connectivity, voltages, statuses, etc.	information.		
Audit of Investment Planning #2014-29 January 30, 2015	2.5 Continue to develop sufficiently detailed Asset Strategy Documents for all asset groups and ensure that all future asset needs are assessed against these documented strategies.	We will continue to develop Asset Strategy Documents.	M	Completion Date Q4, 2016. Schedule at risk due to Tx Rate Application and Business Planning work in Q2, and rate case defense in Q3 and Q4. Will reassess as we move closer to Q4.
Audit of Investment Planning #2014-29 January 30, 2015	**3. Investment Alternatives**			
	3.1 Increase the numbers of investments that are optimizable by requiring the planners to define more than one alternative for non-demand driven programs and time shift-able projects. Management should also ensure that appropriate justification is documented and reviewed for plans having only a single alternative.	We will define the framework for investments including the expectations outlining the definition and governance of programs and projects and requirements for program alternatives and time shift-able projects. Document and communicate these requirements.	H	**COMPLETE** – Q3, 2015 Review of Bus Plan will be done in Q4 to determine gaps areas in programs or investments without multiple alternatives.
Audit of Investment Planning #2014-29 January 30, 2015	3.2 Simplify the risk assessment matrix and provide suitable training and guideline to planners to perform an effective risk assessment. Specific focus should be on	We will improve the guidance on the use of the risk assessment matrix through the provision of practical examples.	M	**COMPLETE** – Q4, 2015.

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	using quantitative data from AA and other systems to determine/support appropriate probability and consequence on the established risk matrix.			
Audit of Investment Planning #2014-29 January 30, 2015	3.4 Review and confirm the Unit Price Catalogue with the service providers prior to the start of each planning cycle to ensure that the most current unit prices are being used to determine the funding level for the program work.	We will establish a process to ensure costs included in the investment plans are agreed upon between Planning and Operations (executing LOBs).		**COMPLETE** – Q4, 2015 The Investment Planning process has included a deadline for the Service Provider to provide a draft Unit Price Catalogue (UPC) and a deadline for the Asset Manager (Planners) to review and accept the UPC. This process and deadlines were communicated to the Director Level btw December 3rd and 9th, 2015.
Audit of Investment Planning #2014-29 January 30, 2015	**4. Investment Plan Optimization**			
	4.2 Make the AIP tool available year around to allow the planners to input and update their plans and risk assessments throughout the year. Management has indicated that plans are already underway to upgrade the AIP tool to allow this to occur in 2015.	This recommendation will be addressed upon implementation of AIP tool upgrade.		**COMPLETE** – Q3, 2015 The new version of the tool (v8.3) will provide more opportunities for sub-cost segment optimization to improve risk normalization within planning functions. However, it does not permit year round use by planners to input and update their plans throughout the year as originally envisioned. In order to have a constantly availability of the AIP, Hydro One would require two instances of the tool running in parallel. This would require two servers and a complex syncing processes and scripts that do not

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
				currently exist and would be costly and difficult to implement. As such, the output of the investment planning process still requires a freeze period to tie to the financial models as part of the corporate business plan. The freeze period is between IRRC approval of the IPP and the Hydro One Board approval of the corporate business plan. Starting in 2016 the tool will be made available immediately after from Board approval in November, this will provide 6 additional months of availability. For the freeze period Planners are encouraged to continuously review the state of their assets, and assess system and customer needs. For projects, SAP and the ACER process is used to continuously update project/integrated program timing, expenditure projections, etc. Once AIP is available, planners can input the updated plans.
Audit of Investment Planning #2014-29 January 30, 2015	4.4 Increase the enterprise engagement period to allow a detailed line by line review of unreleased work in the IPP by the project and program managers who will be executing the plan. This will allow better feedback on cash flows and in-service	Enterprise Engagement period will be revised and incorporated into the revised schedule for the 2016-2020 planning cycle.	H	**COMPLETE** – Q2, 2015 The Enterprise Engagement period was extended as part of the 2016-20 Investment Planning Process and communicated as part of the Director Kick-off (Feb 20, 2015). Planning and the execution LOBs were encouraged to discuss preliminary plans,

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	dates from the service providers based on the established scope.			costs and risks associated with investments during the input period (Feb 1-March 30).
Audit of Investment Planning #2014-29 January 30, 2015	4.5 Implement a formal change log to document all recommended changes. This should also include appropriate review, approval and incorporation of changes with appropriate communication back to the requestor of the change.	All changes will be recorded in the accomplishment file change log and/or documented in the meeting minutes.		**COMPLETE**
Audit of Investment Planning #2014-29 January 30, 2015	4.6 Determine and document which types of changes to the individual plans require the IPP to be run through the optimization process again to ensure that the resulting plan remains optimal.	AM Process & Tools will document conditions and requirement for the IPP to be run through the optimization process again into the Investment Optimization Management Procedure.		**COMPLETE** – Q1, 2015
Audit of Investment Planning #2014-29 January 30, 2015	**5. Investment Plan Approval and Release**			
	5.1 Clarify the approval requirement and progress monitoring for "program" investments. Review the project and program approval process with specific focus on shortening the approval timeline. This may	This will be incorporated into annual review of OAR.		**COMPLETE** – Q4, 2015 All program investments are being converted to projects and will following the mature and robust processes already in place for project initial approvals and variances.

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	include appropriate escalation triggers as well as clarification of requirement for timely review / approval.			
Audit of Driver Safety #2014-30 January 21, 2015	**1.1 Corporate Level Strategic Direction and Accountabilities**			
	(a) Rationalize and assign overall accountability for the governance of an effective Driver Safety Management initiative, in accordance with Craft of Management principles, taking into account the observations and recommendations outlined in the remainder of this report. (b) Develop and define corporate level strategic direction for Driver Safety which clearly identifies accountabilities, initiatives, and objectives / targets, and cascades from the Hydro One Strategic Plan and Health and Safety Policy, to the LOB level, through the Networks' Health, Safety and Environment Management System. Communicate the Driver Safety direction and monitor its implementation.	(a) A Networks-level Driver Safety Program will be developed to address the Findings and Recommendations of this Audit. Health, Safety and Environment Division will take the lead role in facilitating the process, stakeholdering, and developing this Program. (b) A Networks-level Driver Safety Program will be developed to address the Findings and Recommendations of this Audit. Health, Safety and Environment Division will take the lead role in facilitating the process, stakeholdering, and developing this Program.	M	(a) **COMPLETE** – Q3, 2015 (b) **COMPLETE** – Q3, 2015

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
Audit of Driver Safety #2014-30 January 21, 2015	**1.2 Driver Safety Documentation**			
	Review, rationalize and consolidate documentation regarding Driver Safety to ensure it is current and provides clear and coordinated direction. Incorporate relevant requirements from existing and previous documents into the Driver Safety strategy, including SP 0371 R0, Bulletin BU 0796, and the JTZ MVA Reduction Team recommendations.	Refer to the Proposed Action Plan for Finding 1.1 - Corporate Level Strategic Direction and Accountabilities.	M	**COMPLETE** – Q3, 2015
Audit of Driver Safety #2014-30 January 21, 2015	**3.2 Monitoring Distracted and Impaired Driving**			
	(a) Implement a process in all LOBs to monitor and assess driver skill and fitness / condition. (c) Investigate a process for supervisors to formally monitor, on a regular basis, compliance with the Highway Traffic Act - Hours of Service Regulation (O. Reg. 555/06).	Refer to the Proposed Action Plan for Finding 1.1 - Corporate Level Strategic Direction and Accountabilities.	M	**COMPLETE** – Q3, 2015
Audit of Driver Safety #2014-30 January 21, 2015	**3.4 Monitoring CVOR Infractions**			
	(a) Evaluate consolidating the multiple CVOR registrations into a single registration. (b) Re-evaluate the requirements stated in SP	Refer to the Proposed Action Plan for Finding 1.1 - Corporate Level Strategic Direction and Accountabilities.	M	**COMPLETE** – Q3, 2015

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	0371 R0 - Hydro One Networks Requirements for On-Road Vehicle Operation, including: • CVOR audits to be conducted every three years by external auditors; • Quarterly CVOR abstracts; and • Consider reinstating a mechanism (e.g., the CVOR Compliance Officer position) to fulfill the CVOR monitoring and reporting responsibilities, including reporting CVOR violations to drivers and other appropriate Departments within Networks to increase awareness and potentially prevent future violations.			
Audit of Driver Safety #2014-30 January 21, 2015	**4.1 Inspections and Monitoring**			
	(a) Implement a formal process to track completion of vehicle inspections, including corrective actions, for all Networks' fleet vehicles (light and CVOR vehicles). (b) Review and consolidate the direction for conducting and monitoring vehicle inspections.	Refer to the Proposed Action Plan for Finding 1.1 - Corporate Level Strategic Direction and Accountabilities.		**COMPLETE** – Q3, 2015

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
Audit of Driver Safety #2014-30 January 21, 2015	**5.1 Reporting, Trending and Analysis**			
	(a) Review ICM MVA reporting criteria to ensure adequate capture of MVA incidents, including vehicle damage incidents, to improve safety statistics, and revise SP 0070 R9 – H&S Incident and Regulatory Event Reporting, Investigation and Corrective / Preventive Action as appropriate. (b) Implement a quality control process to ensure all MVA data is entered accurately into ICM or its replacement. (c) Analyze and identify trends related to MVAs and make available to all staff to aid in preventing future accidents and near-misses.	Refer to the Proposed Action Plan for Finding 1.1 - Corporate Level Strategic Direction and Accountabilities.	M	**COMPLETE** – Q3, 2015
Audit of Driver Safety #2014-30 January 21, 2015	**5.2 Investigation**			
	(a) Consider conducting more investigations on MVAs to potentially prevent similar incidents. (b) Clearly define and document the criteria for determining when System Investigations should be conducted on MVAs. (c) Re-evaluate the team	Refer to the Proposed Action Plan for Finding 1.1 - Corporate Level Strategic Direction and Accountabilities.	M	**COMPLETE** – Q3, 2015

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	member makeup on MVA investigations, and consider adding Subject Matter Experts from Fleet Services Department and/or Training and Development Services Department. (d) Include results of MVA Local Investigations in the Incident and Claims Management System, or its replacement, and communicate across Networks as appropriate.			
Audit of Fleet Environmental Impacts #2014-31 January 21, 2015	**1.0 Corporate Level Strategic Direction and Accountabilities**			
	(a) Reconcile and assign accountability for the governance of an effective fleet environmental impact management initiative, in accordance with Craft of Management principles, taking into account the observations and recommendations outlined in the remainder of this report. (b) Develop, define and document corporate level, strategic direction for fleet environmental impacts which clearly identifies	(a) Target has been completed. Greenhouse Gas Management Plan has been completed and posted to HODS Jun 5, 2015. GHG Management Plan establishes accountabilities for each LOB. Greener Choices HydroNet page has been updated to include (i) group mandate/definition and (ii) linked to A to Z links on HSE page. (b) SP1612 created and approved.	M	(a) **COMPLETE** – Q3, 2015 (b) **COMPLETE** – Q4, 2015

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	accountabilities, initiatives, and objectives / targets, and cascades from the Hydro One Strategic Plan and Environment Policy, to the LOB level, through the Networks' Health, Safety and Environment Management System. Communicate the fleet environmental impact direction and monitor its implementation.			
Audit of Fleet Environmental Impacts #2014-31 January 21, 2015	**5.0 Performance Reporting, Trending and Analysis**			
	(a) Review and revise the reporting processes for greenhouse gas data to ensure there is a single source of truth. (b) Monitor, analyze and report fleet environmental impacts to aid in reducing air emissions and kilometres driven.	(a) Greenhouse Gas Management Plan posted on June 5, 2015-SP1612, which defines the reporting process for greenhouse gas data. Standardized templates included in Appendix C- GHG Data Collection Template. (b) SP1612- Greenhouse Gas Management - complete. This document assigns various accountabilities across various LoB's for developing targets, monitoring and reporting on GHG's.		(a) **COMPLETE** – Q4, 2015 (b) **COMPLETE** – Q4, 2015

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
Audit of HR Cloud Computing #2014-32 December 17, 2014	**1. Cloud Provider Security Assurance and Practices**			
	We recommend management ensure that: 1. Accountabilities for monitoring Success Factors' (HR System) control reports be clarified. 2. Success Factors' SSAE16 report be reviewed semi-annually. 3. Success Factors' Service Level Agreement metrics be regularly reviewed. 4. Controls identified in the SSAE16 report that are not being managed by the cloud service provider should be assessed to determine if Hydro One has controls in these areas.	The Project will request the appropriate control reports from Success Factors and set the accountability with ISD's Sustainment and Security organizations to review the Service Level Agreement (SLA) and SSAE16 reports. A statement indicating how these actions were disposed of, who were the recipients of the review activities (specifically who in ISD Sustainment and Security), will be submitted by April 30, 2015. This is the planned date of completion of the HR Pay project.		**COMPLETE** – Q4, 2015 Service Organization Control (SOC) 2 Report from Success Factors – Talent Management received from SAP on Sept 1st, 2015.
Audit of HR Cloud Computing #2014-32 December 17, 2014	**2. Information Technology (IT) Security Requirements and Design Documentation**			
	Security requirements and the design to meet these security requirements for the HR Pay Cloud application be summarized and consolidated into one document. The adequacy of security solutions described above should be provided to IT security for their independent review.	Security requirements, design and testing documents for the HR Pay Cloud application will be consolidated and provided to IT Security for their review before completion of the project. Future Corporate Projects will ensure that all security requirements and design considerations are consolidated and reviewed with Security. In multi-phase projects, the initial security		**COMPLETE** – Q1, 2015

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
		requirement document will be updated with subsequent phase information.		
Audit of HR Cloud Computing #2014-32 December 17, 2014	**3. System Acceptance Testing**			
	We recommend management ensure that the Hydro One IT security group perform independent testing of security controls to ensure that the security requirements are met and are in compliance with the Hydro One IT security standards.	Security requirements, design and testing documents for the HR Pay Cloud application will be consolidated and provided to IT Security for their review and sign-off before completion of the project. Future Corporate Projects will ensure that security requirements are tested independently by the Security Group testers.		**COMPLETE** – Q1, 2015
Audit of HR Cloud Computing #2014-32 December 17, 2014	**4. Governance and Cloud Computing Policy or Standard**			
	We recommend management ensure that the cloud computing policy or standard be finalized and published. This will provide requirements for all future cloud computing applications.	The Cloud Computing standard will be reviewed by IT Security and then completed and published.		**COMPLETE** – Q3, 2015 SP1534 Cloud Computing Guideline has been published in HODS.
Audit of Large Customers – Client services #2014-33 January 23, 2015	**Role Clarity**			
	There is a more uniform understanding amongst Executive Sponsors regarding their role. We suggest periodic meeting be held of all Executive Sponsors to discuss the challenges faced and to share experiences and best practices.	Customer Service will review and clarify roles, accountabilities & authorities for Executive Sponsors, Account Executives, Tx Planners & Project Development Engineers in the context of key customer facing processes. This will include participation by other key LOBs, such as Tx Planning, Conceptual		**COMPLETE** – Q3, 2015 Individual meetings have been completed with all Executive Sponsors to review role, accountabilities, objectives and training materials. Updated training materials have been provided following the upgrade of CRM in August. The next meeting for all Executive Sponsors is scheduled for

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
		Engineering and Project Development.		October 14.
Audit of Large Customers – Client services #2014-33 January 23, 2015	**Training/Briefing Account Executives and Executive Sponsors**			
	Implement a formal training program for both Account Executives and Executive Sponsors.	Customer Service will further develop and implement a comprehensive training program for Executive Sponsors, Account Executives, Tx Planners and designated staff in key LOBs. This will include training requirements based on roles and use of CRM as well as in-person training, soft & hard copy materials. Performance evaluations of Account Executives will be used as an input to developing training requirements. In addition a procedure will be developed specifying actions to ensure appropriate match of skill sets with customer needs, knowledge transfer and a "hand-off" when people change in Executive Sponsor and Account Executive positions.	M	**COMPLETE** – Q3, 2015 Formal training program for Exec Sponsors developed and delivered. Formal training program based on roles and accountabilities in the revised job doc for Account Execs has been developed and is being implemented.
Audit of Large Customers – Client services #2014-33 January 23, 2015	Develop a training and reference manual for Account Executives and Executive Sponsors and ensure that it is updated regularly. The manual should describe Hydro One's obligations (including regulatory obligations) in clear and concise terms.	Same as Action Plan for Recommendation #1. Customer Service will further develop and implement a comprehensive training program for Executive Sponsors, Account Executives, Tx Planners and designated staff in key LOBs. This will include training requirements based on roles and use of CRM as well as in-person training, soft & hard copy materials. Performance evaluations of Account Executives will be used as an input to developing training requirements. In addition a procedure will be developed specifying	M	**COMPLETE** – Q2, 2015 The training and reference manual for the Executive Sponsors and Account Executives are on SharePoint and will be updated as required. Hardcopy reference manuals have been provided to a few Executive Sponsors as requested.

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
		actions to ensure appropriate match of skill sets with customer needs, knowledge transfer and a "hand-off" when people change in Executive Sponsor and Account Executive positions.		
Audit of Large Customers – Client services #2014-33 January 23, 2015	**Relationship Succession/Continuity Planning**			
	The roles and responsibilities of the Account Executive based on actual work performed.	Customer Service will review and clarify roles, accountabilities & authorities for Executive Sponsors, Account Executives, Tx Planners & Project Development Engineers in the context of key customer facing processes. This will include participation by other key LOBs, such as Tx Planning, Conceptual Engineering and Project Development.	M	**COMPLETE** – , Q3, 2015 The roles and responsibilities in the job doc for Account Execs has been updated based on the actual work performed. A copy of the updated job doc is attached. The role of Executive Sponsors has been reviewed with all Exec Sponsors in individual meetings and clearly specified in Exec Sponsor training materials which were also reviewed with each Exec Sponsor. The roles and accountabilities of staff of all relevant LOBs are clearly defined in the Tx Load Connection Process and embedded in the related work flows in CRM.
Audit of Large Customers – Client services #2014-33 January 23, 2015	**Tracking Customer Interactions – Responsiveness and Communication**			
	Use of the CRM mandated through a formal procedure	Customer Service will develop procedures and related reporting to specify and enable: – Use of CRM for all relevant customer information, particularly commitment dates and quality and type of information; Prioritization of customer commitments; – Performance of LOBs in cross-	M	**COMPLETE** – , Q3, 2015 The Tx Load Connection Process specifies the use of CRM by all relevant LOBs to track and update status of activities & Customer commitments. The Account Exec job doc has been updated to require use of CRM plus updated CRM training materials for Account Execs and Exec Sponsors specify the use of of CRM. In

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
		functional processes and adherence to project timeframes; – Expanded dashboard view of upcoming due cases & aging of overdue cases; – Escalation protocol; – Progress of Executive Sponsor efforts; – Status of LOB specific efforts; – Compliance with regulatory requirements; – Opportunities for customer service enhancement.		addition, the weekly CRM active case reports have been revised to clearly outline expectations for overdue and upcoming customer commitments.
Audit of Large Customers – Client services #2014-33 January 23, 2015	Develop better remote access to the CRM.	Customer Service will develop procedures and related reporting to specify and enable: – Use of CRM for all relevant customer information, particularly commitment dates and quality and type of information; Prioritization of customer commitments; – Performance of LOBs in cross-functional processes and adherence to project timeframes; – Expanded dashboard view of upcoming due cases & aging of overdue cases; – Escalation protocol; – Progress of Executive Sponsor efforts; – Status of LOB specific efforts; – Compliance with regulatory		**COMPLETE** – Q2, 2016 CRM mobile solution provided by ISD has been tested successfully for mobile phone usage with all OS platforms with the exception of Android. Inergi has sent out the access email and work instruction to Key Account staff to self-install the mobile apps on their phones. User's responses have been positive. Users currently with Android phones will either need to switch to another platform (either Blackberry or Apple) or have their phone tethered to a tablet as an alternate solution being developed by ISD. Mobile solution will be rolled out to a larger audience once the production solution has been stabilized by this first round of usage by the Key Account staff.

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
		requirements; – Opportunities for customer service enhancement.		
Audit of Large Customers – Client services #2014-33 January 23, 2015	Standards are established.	Customer Service will continue to identify/develop/ optimize key customer processes including establishing, communicating & monitoring process standards such as cycle times and produce exception reports. This will include provision of process documentation to customers, standardized cost estimates, addressing administrative timelines, and a procedure for annual process review as needed. In addition, there will be an assessment of how to incorporate customer satisfaction drivers as identified by the annual survey.		**COMPLETE** – Q2, 2015 Standards have been established for completion of Tx load connection project milestones where appropriate as part of the Tx load connection process and recognizing the large variation in the complexity of such projects.

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
Audit of Large Customers – Client services #2014-33 January 23, 2015	Exception reports are produced for review and follow-up when there is non-compliance.	Same as Action Plan for Recommendation #1. Customer Service will continue to identify/develop/ optimize key customer processes including establishing, communicating & monitoring process standards such as cycle times and produce exception reports. This will include provision of process documentation to customers, standardized cost estimates, addressing administrative timelines, and a procedure for annual process review as needed. In addition, there will be an assessment of how to incorporate customer satisfaction drivers as identified by the annual survey.		**COMPLETE** – Q2, 2015 Exception reports are produced as part of the Tx load connection process. These exception reports are reviewed and updated monthly and reviewed in a monthly meeting by designated LOB senior staff and are also provided to LOB senior management.
Audit of Large Customers – Client services #2014-33 January 23, 2015	Standardized process documentation for all common transmission load connection processes. This documentation should be given to the customer as part of a package at the outset, so the customer understands the full process, including when its own actions can cause delays to the outcome.	Customer Service will continue to identify/develop/ optimize key customer processes including establishing, communicating & monitoring process standards such as cycle times and produce exception reports. This will include provision of process documentation to customers, standardized cost estimates, addressing administrative timelines, and a procedure for annual process review as needed. In addition, there will be an assessment of how to incorporate customer satisfaction		**COMPLETE** – Q2, 2015 Documentation which describes the standard Tx load connection process has been produced and is provided to customers as well as being available on the Hydro One website.

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
		drivers as identified by the annual survey.		
Audit of Large Customers – Client services #2014-33 January 23, 2015	Standardized cost estimates with more details on how the amount was determined.	Same as Action Plan for Recommendation #1. Customer Service will continue to identify/develop/ optimize key customer processes including establishing, communicating & monitoring process standards such as cycle times and produce exception reports. This will include provision of process documentation to customers, standardized cost estimates, addressing administrative timelines, and a procedure for annual process review as needed. In addition, there will be an assessment of how to incorporate customer satisfaction drivers as identified by the annual survey.		**COMPLETE** – Q2, 2015 Standardized cost estimate template and standard feasibility study template have been developed and stakeholdered internally, based on customer input re expect level of cost breakdown.
Audit of Large Customers – Client services #2014-33 January 23, 2015	Review Hydro One procedures to substantially shorten the timelines on administrative matters.	Same as Action Plan for Recommendation #1. Customer Service will continue to identify/develop/ optimize key customer processes including establishing, communicating & monitoring process standards such as cycle times and produce exception reports. This will include provision of process documentation to customers, standardized cost estimates,		**COMPLETE** – Q1, 2015 Procedure revised to reduce time to issue invoices for connection process agreements from 4 weeks to 1 week. This was the only significant administrative process issue identified.

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
		addressing administrative timelines, and a procedure for annual process review as needed. In addition, there will be an assessment of how to incorporate customer satisfaction drivers as identified by the annual survey.		
Audit of Large Customers – Client services #2014-33 January 23, 2015	Tracked information should be analyzed for compliance with regulatory requirements.	Customer Service will develop procedures and related reporting to specify and enable: – Use of CRM for all relevant customer information, particularly commitment dates and quality and type of information; Prioritization of customer commitments; – Performance of LOBs in cross-functional processes and adherence to project timeframes; – Expanded dashboard view of upcoming due cases & aging of overdue cases; – Escalation protocol; – Progress of Executive Sponsor efforts; – Status of LOB specific efforts; – Compliance with regulatory requirements; – Opportunities for customer service enhancement.		**COMPLETE** – Q3, 2015 Procedure to review tracked information with respect to regulatory compliance has been developed and a report summarizing the results from this review has been developed. See attached Tx Load Connection Compliance Report.

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
Audit of Large Customer Connection and Cost Recovery Agreement True-up #2014-34 January 23,2015	**4. Tracking Customer Load Consumption, True-up Calculations and Settlements**			
	We recommend that management ensure that true-ups are completed on time when they become due.	Customer Service will implement the CDM & DG load adjustment guidelines as soon as they are finalized (expected by end of Q1 2015) and develop and implement a schedule with the participation of other relevant LOBs to address the backlog of CCRA true-ups in a prioritized approach. In addition, there will also be a monthly status report for overdue true-ups for monitoring purposes. Past due true-up obligations will be triaged and addressed in order of priority.	M	**COMPLETE** – Q2, 2015 CDM & DG load adjustment guidelines were finalized and implemented in Q1 and have been communicated to customers in writing plus meetings for purposes of clarifications where customers have questions or concerns. See guidelines. http://www.hydroone.com/IndustrialLDCs/ConnectionProcess/Pages/Getting-Started-s.aspx. A schedule has been developed with the participation of Tx Planning and Decision Support to address all outstanding and due CCRA true ups. Weekly meetings have been implemented with the LOBs noted above as well as a weekly report and dashboard.
Audit of Large Customer Connection and Cost Recovery Agreement True-up #2014-34 January 23,2015	We recommend that management put in place processes that: 1. Ensure staff are clear at what point a true-up is needed. 2. Enhances the cost aggregation and accuracy of data. 3. Document all facts to prevent loss of information due to staff turn-over. 4. Facilitate work coordination amongst various LoBs i.e.,	Customer Service with participation of other relevant LOBs will develop a procedure to ensure all internal parties are aware of timeframes, cost information quality requirements for true-ups, the use of CRM to document all information for true-ups and workflow between LOBs. This will be a narrative of the recently implemented CCRA true-up process. In addition, enhanced reporting of progress of true-ups will be implemented for both management oversight purposes and	M	**COMPLETE** – Q3, 2015 Enhanced reporting of true up status implemented with dashboard of status of current due or overdue true ups. Regular communications to customers with active true ups has been developed and implemented. A schedule of all due and overdue true ups and related action plan has been developed and implements with participation of all relevant LOBs. Revisions to the CCRA template have been developed to ensure all information needed for true up activities

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	Real Estate. 5. Enhance communication with customers to avoid signalling wrong messages. 6. Enhance the reporting process to keep the customer abreast of project activities. 7. Ensure true-ups are completed in a timely manner.	communications to customers.		is captured in the agreement and customers are aware of required information. CCRA model has been updated and is provided to customers upon request subject to an NDA.
Audit of Large Customer Connection and Cost Recovery Agreement True-up #2014-34 January 23,2015	**5. Large Generation Customers**			
	We recommend that management ensure that the estimating process involves more in-depth analysis of costs in order to minimize the gap between actual and estimated costs.	Drive an in-depth transmission generation/load project reconciliation and close true-up/review process involving; Planning, Project Management, Project Development, Finance and KAM. The primary objective of this initiative is to improve project estimating/scheduling and execution. This process will drive the preparation of a high level report addressing project, planning to in-service, changes to cost, scope and opportunities to improve estimating/scheduling and project execution/management.	M	**COMPLETE** – Q4, 2015
Audit of Large Customer Connection and Cost Recovery	**6. Large Customer Costs True-up or Reconciliation**			
	We recommend that management ensure that: 1. A process is put in place to	Customer Service and Network Connection Development will drive an in-depth transmission generation; load	M	**COMPLETE** – Q4, 2015 Network Connections completed the process to ensure all actual costs are

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
Agreement True-up #2014-34 January 23,2015	aggregate all costs prior to the cost true-up/reconciliation. 2. A process is put in place for all stakeholders to confirm their costs prior to the true-up/reconciliation. 3. A process is in place to validate the final cost true-up/reconciliation. 4. The project is closed with no ability to charge additional costs once the true-up/reconciliation is completed. 5. Exception reporting is introduced to report additional cost and to request direction to settle those additional charges.	project reconciliation and actual cost true-up review with other relevant LOBs. The primary objectives of this review are to improve project estimating/scheduling and execution and assess the current 180 day timeline to perform actual cost true-up to see if we can realistically expect to have all cost information when required, mechanism to ensure costs booked in SAP are identical to costs used in true-up calculations and identify barriers. Recommendations from this review will be implemented to achieve the 180 day timeline, or in cases where this is not feasible, implement other potential solutions Initiate the review of Project Management and Finance project cost reporting/tracking processes. Establish an LOB supported process that accurately tracks project costs and respects true-up/ reconciliation within the targeted 180 day after in-service.		reported in a timely manner to allow the Actual Cost Reconciliation to be completed within 180 days.
Central Maintenance Services Finance & Operations Controls #2015-03	**1.1 CMS Facility Power Upgrades Needed to Protect Assets**			
	The Project Management team should work with all business units involved in the CMS Facility Power Upgrade project to ensure the upgrade project achieves successful	The Facility Power Upgrade Project Manager is accountable for completing the project on time within assigned parameters in accordance with the Company's procurement policies. The Project Manager has been moving the		**ONGOING** Design drawings have been prepared to start work, to complete the project by Oct 2017.

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
April 10, 2015	commencement in 2015 to mitigate the risk of ESA rule violations.	project forward and will continue to coordinate with CMS.		
Central Maintenance Services Finance & Operations Controls #2015-03 April 10, 2015	**1.3 CMS Facility Power Upgrades Needed to Protect Assets**			
	Management should ensure upgrades to the secure assets room are completed in a timely manner, mindful of competing priorities.	The secure assets room upgrade will be completed in accordance with Asset Management guidelines and as per purchasing policy.		**COMPLETE** – Q2, 2016 This job has been successfully completed.
Central Maintenance Services Finance & Operations Controls #2015-03 April 10, 2015	**2.1 ISD Enhancements and Further Centralized Use of Asset Status Tracking System**			
	CMS has submitted initial enhancement requests for automation. Management should ensure ISD support is secured to develop the necessary system enhancements to automate parent-child updates, to allow for timely updates to SAP and avoid miscommunication regarding status of transformers. Periodic reconciliation of SAP and secondary database records should be performed until a full SAP fix is achieved to ensure all parties within the company are aware of the actual status of key OS transformers.	CMS management will follow up on the enhancement request to SAP automate transformer readiness code changes that has been submitted to ISD, mindful of the fact that CMS is not able to control the IT development schedule, to ensure that the enhancement is completed promptly. Reconciliations will be performed in the interim to ensure that manually tracked readiness changes are provided to MTS and AM.		**COMPLETE** – Q4, 2015 Automation process has been tested and is in full production. SAP is up to date in regards to readiness.

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
Central Maintenance Services Finance & Operations Controls #2015-03 April 10, 2015	**2.2 ISD Enhancements and Further Centralized Use of Asset Status Tracking System**			
	Although Maintenance Technical Services (MTS) staff are aware of the limitations of their independent database and operate accordingly to avoid misunderstanding, outside business units were previously not aware that records in Spares and Repairs did not necessarily reflect asset condition in SAP, which represented the most current status. To minimize future confusion as well as redundant data input activities, use of the independent database should be phased out in favour of using SAP when the necessary SAP reporting functionalities are available. Prior to such a phase-out, adequate system acceptance testing and end user training should be prepared and delivered to ensure that when staff move from using the Spares and Repairs database they are able to easily identify the equivalent functions in SAP to carry out their assigned duties.	MTS will complete a request to ISD to automate this process.		**COMPLETE** – Q2, 2015 Request submitted to ISD on March 27, 2015.

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
Central Maintenance Services Finance & Operations Controls #2015-03 April 10, 2015	**5.0 Controls over OM&A and Capitalization**			
	Representatives from Corporate Finance should be consulted as needed on major refurbishment programs classified as OM&A to ensure classification of work is correct.	CMS will coordinate with the Work Management and Corporate Finance group to ensure major refurbishments are classified and charged appropriately.		**COMPLETE** – Q1, 2015 Plan has been acted upon.
Central Maintenance Services Finance & Operations Controls #2015-03 April 10, 2015	**7.0 Transformer Warranty Work Reimbursement**			
	Although the initial accountability for warranty claims was assigned to individual project managers, the Supply Chain Commercial Operations Office is in a strong segregated and strategic position to oversee the design of a consistent process to record and charge back vendors for agreed warranty reimbursements, for both CMS and all business units across the company.	A process for consistent warranty claim recovery is under development under the oversight of the Supply Chain Commercial Operations Office.		**ONGOING** In the plan for 2016.
Central Maintenance Services Finance & Operations Controls #2015-03 April 10, 2015	**11.0 Inventory Management Enhancements**			
	Management should coordinate with ISD to take appropriate technical measures to ensure the Wi-Fi network is resilient, to avoid downtime.	CMS will request a “lessons learned” document from ISD to ensure the cause of prior Wi-Fi outages is determined and preventative measures are taken to prevent recurrence.		**COMPLETE** – Q3, 2015 No further issues have been encountered. Action complete.

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
Asset Deployment #2015-05 May 21, 2015	**1. Asset Deployment Process**			
	Establish a single point of accountability (Process Owner) for the overall end-to-end asset deployment process. Ideally, the Process Owner would establish oversight controls (e.g. conduct periodic meetings including LoB/Asset Deployment stakeholders and report on process status and identify opportunities for further improvement). The Process Owner would establish and monitor key processes (e.g. Lessons Learned) to identify process improvements and facilitate cross-LoB process improvements.	The COO will request Internal Audit to attend a meeting with the appropriate line of business VP's and the Director of Engineering to lead the group through and to review the issues identified through this audit. The Director of Work Program Management will attend and a mitigation plan will be established that will be tracked by the Director of Work Program Management for the COO.		**COMPLETE** – Q3, 2015 A process flow has been developed and stakeholdered.
Asset Deployment #2015-05 May 21, 2015	**2. Asset Deployment Risks**			
	Establish a high level (cross-LoB) risk assessment approach to address risks of the overall Asset Deployment process inefficiencies involving deployment of assets.	The COO will request Internal Audit attend a meeting with the LoB VP's and Directors' as noted above to talk about how a One Company approach can be used to address issues related to work initiation, project risk identification, etc. If appropriate and if the business agrees a risk register will be established but at a minimum it will be agreed that the interlinked business process, issues and inefficiencies will be discussed for action to be taken annually.		**COMPLETE** – Q3, 2015 A high-level risk assessment workshop was held and a separate process was established to identify and manage project risks.

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
Asset Deployment #2015-05 May 21, 2015	**3. Performance Measures**			
	Establish metrics within each business function affecting the Asset Deployment process with the ability to aggregate up at the COO level to provide an indication of Asset Deployment effectiveness. The metrics should provide incentives for management to drive quality and continuous improvements (i.e. drive efficiencies and productivity through improved process, controls, tracking, monitoring and reporting). Include leading measures to provide indications for areas that require more management focus and attention.	A plan will be created to establish metrics from contributing LoB business leads to provide monitoring of the end-to-end Asset Deployment process. As noted above, working with Internal Audit who will act as the facilitator as noted in recommendation 1 establish reasonable LoB metrics which can be easily tracked that will meet the issues identified, consistent with the objective of affecting improved Asset Deployment Effectiveness.	M	**COMPLETE** – Q3, 2015 Asset Deployment Dashboard has been developed to monitor KPIs.
Asset Deployment #2015-05 May 21, 2015	**4. Project Estimating**			
	(a) Project Definition to ensure that LoBs have an Understanding of the estimating process and establish alignment of LoBs to the process. Ensure that there is a clear and unified understanding of the project definition process including associated terminology among the LoBs involved in this	(a) Project Definition to lead the estimating process and associated changes so that involved Lines of Businesses are aligned. Reinforce the estimating process with controls, monitoring of KPIs and feedback to drive efficiencies and effectiveness through continuous improvement of the process. Provide instruction to LoBs to ensure a unified understanding of the project definition process,	M	**COMPLETE** – Q4, 2015 (a) New estimating process and tools have been developed.

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	process. (b) Controls should be established to identify, report and manage the backlog of ARs that have not yet entered the CES. (c) Project Definition to explore an integrated solution for project estimation and overall project definition processes and optimize data collected within SAP.	accountabilities and roles from involved LoBs. (e.g. clarify use of terms such as "categories" and "tiers") (b) Project Definition will establish controls to identify and manage the backlog of ARs that have not yet entered the CES. Establish measures to track the estimating process (i.e. from CES) and ensure that it is effective and report the process measurement results to management of affected LoBs. (c) Project Definition will explore solutions that provide a more integrated approach to the project definition function including the estimating process. (e.g. a solution to better leverage data within SAP).		(b) AR Backlog for CES has been addressed. (c) Testing and commissioning of a new estimating tool is underway.
Asset Deployment #2015-05 May 21, 2015	**5. Project Communication**			
	Establish a protocol and a procedure that ensures more visibility and opportunity to all affected LoB stakeholder including, Station Services for input to pending projects at both the (a) pre-release and (b) post-release stages.	(a) Project Definition will ensure that Station Services are included in the pre-release planning stages of pending projects. (b) Significant changes to projects (i.e. scope of work, cost, schedule) are reported through our established month-end process. This includes status updates via the standard PP-190 BI report. Variances to major projects are also tabled for discussion to SVP and or EC reviews		**COMPLETE** – Q3, 2015 a) The Estimating-Engineering Process has been redesign and documented to include review and approval by Engineering, Station Services, Project Delivery, Outage Management and Station Services. b) Project Management has implemented an IBU dashboard that tracks work flowing in and out and at what stage in the process cycle they are in.

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		by the Director of Project Management. Project Management has a plan to improve downstream communication with the Station Services on changes to project timing and or scope changes using the existing SAP Work Acceptance Process and Integrated Business Unit (IBU) process. An ongoing dashboard of Station Services required hours will be reviewed on a quarterly basis to identify gaps in the current work program. Further, the IBU process will be refined and communicated in Q2, with the review of the 2016 Work Program.		
Asset Deployment #2015-05 May 21, 2015	**6. Unrealistic In-Service Dates**			
	(a) Pre-release: A risk assessment of the project should take into account the impact of changes to cost/resources/operations, etc. on the project/asset deployment horizon so that execution of project work/asset deployment is realistically achievable. (b) Post-release: Establish controls to mitigate	(a) Establish a process for risk assessments of projects/programs and associated documentation. This is expected to take into account risks to in-service dates, costs and resources. (b) Project Management will continue to coordinate schedule changes of released work with Stations Services and Construction. To mitigate compression of executing timelines, Project Management, Engineering		**COMPLETE** – Q3, 2015 (a) Project Management will continue to coordinate schedule changes of released work with Stations Services and Construction on a bi-weekly basis. Risk assessments and project risk reporting has been established (b) The IBU process has been refined and communicated in Q2, with the review of the 2016 Work Program.

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	compression to Construction Services. Minimize changes to project priorities, particularly once field crews have been deployed. Put controls in place to ensure that once set in motion (i.e. drawings released, Construction Services and/other field crews have been deployed), any further changes to the project are discussed and coordinated with all affected LoBs.	and Construction are working with Asset Management to provide "accelerated future year work for early engineering".		
Asset Deployment #2015-05 May 21, 2015	**7.Long Lead Time Material**			
	(a) Supply Chain with involvement from Planning, Engineering, should establish and document a process to identify and periodically review long lead time equipment expected for upcoming asset deployment projects. This process should focus on managing equipment posing supply risk to future projects, including backlog of equipment contracts that are past or approaching expiration, and	(a) Supply Chain will take lead action to work with LoB stakeholders Asset Management, Corporate Standards, Engineering and Planning & Project Definition to create a formal set of processes complete with sign offs against key milestones that would allow Supply Chain to properly monitor and measure the process from beginning to end. Supply Chain has already developed a draft responsibility matrix, with Corporate Standards, based on the RACI principles which will be stakeholdered with affected Lines of Business.	H	**COMPLETE** – Q3, 2015 (a) Supply Chain has satisfied the Audit requirements through 4 artifacts. They are the Asset Investment Plan, Integrated Sourcing Plan, 18 month Critical Sourcing List and the BI Burn Rate Report. (b) BI reports have been developed which list all active contracts being managed in Supply Chain.

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	communicate these on a periodic basis to internal stakeholders. (b) Supply Chain should actively monitor and report on the status of contracts to senior management. (e.g. track and report contracts that are in place, and which have been extended, single or multiple times) and establish targets for contract status and extensions.	(b) Supply Chain will escalate reporting on status of contracts to COO/Process Owner of end-to-end Asset Deployment process to reinforce action from LoBs required to support the sourcing program.		
Asset Deployment #2015-05 May 21, 2015	**8. Quality Assurance Process**			
	Establish a quality control process with monitoring and reporting to internal stakeholders to address deficiencies with material and equipment delivered to site.	Create a QA process to ensure material and equipment meet required standards, process and shall be bi-directional between technical authorities and end users (Construction, Station Services, Maintenance &Technical Services) for power system equipment and materials that can impact the major equipment.		**COMPLETE** – Q3, 2015 Alert 0386 has been sent out to use existing QA process in HODS SP 0365.
Asset Deployment #2015-05 May 21, 2015	**9. Staged Release of Work**			
	Establish protocols and agreed to timeframes for input from stakeholder LoBs involved in the asset deployment process for build stage release approaches that work best. Achieve complete release of drawings	(a) Establish a Performance Measure to increase the proportion of engineering work completion in advance of construction start. (b) Project Management is accountable to conduct a "project kick-off" meeting with applicable project		**COMPLETE** – Q2, 2015 (a) Performance measure has been established for forecasting % of annual engineering plan completion. (b) The project kick-off process is well entrenched in the Construction Culture and is performed for each

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	and materials by discipline e.g. civil, mechanical, and electrical. Ongoing communication between Project Management, Engineering, Construction Services and Station Services is key.	partners at the start of project execution. This meeting will address key milestone dates and timelines of engineering deliverables and environmental approvals to support Construction and Stations, project risks, and outage staging requirements. This process already exists. Emphasis and clarification of this process will be given to the Project Management division.		project post release.
Asset Deployment #2015-05 May 21, 2015	**10. Project Closeout Process**			
	Continue efforts to implement the improved Project Close-out process and implement monitoring to ensure that the Project Close-out process is completed that includes close-out documentation (e.g. reports, minutes of meetings, follow up action tracking).	Project Management re-introduced the Project Close-Out Process in 2014. Further efforts are underway to ensure projects greater than $5M have a close-out document completed and that stakeholder feedback and reviews are completed in the interest of continuous improvement. An executive summary of these project close-outs and reviews is being created and is expected to be functional for communicating by the end of second quarter.	M	**COMPLETE** – Q2, 2015 The process has been updated and communicated via monthly meetings in February of 2015 to all Project Managers.
Asset Deployment #2015-05 May 21, 2015	**11. Official Documentation**			
	We recommend that management conduct a review to ensure that staff can effectively and efficiently retrieve all the necessary	Senior Management will discuss with the input and guidance of internal audit the desire and need to replace and modernize the HODS system. From that discussion, a decision will be made	M	**COMPLETE** – Q3, 2015 The agreement reached at EC Meeting was that the conversion of all documents to a HODS format or to a new format or the introduction of a new document

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	documents relevant to their work relating to the Asset Deployment process.	to direct IT to investigate technical options available to the Company to modernize its document record system in accordance with good practices demonstrated in other jurisdictions. The COO will raise this item for discussion at the EC. On an ongoing basis where documents are identified in systems as being inconsistent and hence presenting an issue as to Asset Deployment the inconsistency in documents will be highlighted, brought to the attention of the Director, Work Program Management recorded, provided to Asset Management to resolve and to report back on their resolution. On a quarterly basis the number of documents identified and in progress will be reported at the EC month end review.		management system was not considered to be a valuable investment or warranted at this time.
Review of Project Management Controls on the NMS Update Project #2015-06 June 26, 2015	**3. Scope Management**			
	(a) All the high priority risks associated with the undocumented requirements are identified by the business and mitigated before commissioning this project. (b) Requirements identified are reviewed, approved and signed off by the stakeholders.	(a) & (b) The project will continue to document the base functionality as time permits. Any remaining work will be transitioned to a sustainment group. (c) The project will recommend a plan to transition outstanding requirements work to sustainment organizations.		**COMPLETE** – Q1, 2016

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	(c) A test case strategy is developed for all documented requirements identified in the Traceability Matrix.			
Review of Project Management Controls on the NMS Update Project #2015-06 June 26, 2015	**4. Time and Schedule Management**			
	(a) All changes to the project time schedule are made through change requests that have been reviewed and approved by the Manager, Business Management and Project Sponsors. For a potential change having a significant impact on the time schedule, an IROV should be initiated and approved. (b) Develop a critical path for the project and explore with other project teams, such as NERC CIPv5, integration points which can have a significant impact on the project's critical path. These activities should be closely monitored to avoid potential delays for the completion of the project.	(a) Project management will execute the change request for the change in the schedule due to the delivery of network firewalls. (b) The Manager of Business Management will recommend formalization of a critical path analysis to the Manager, Compliance for inclusion into the ISD Delivery Model. This may include critical path analysis that incorporates integration management. The NMS project has processes for critical path analysis but has not integrated this with the NERC CIP v5 project.		**COMPLETE** – Q2, 2015

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Review of Project Management Controls on the NMS Update Project #2015-06 June 26, 2015	**4. Cost Management**			
	(a) Finalize and obtain approval for journal entries from the stakeholders for the transfer of cost to other projects. (b) Applying earned value reporting tool for an effective reporting and analysis of the project progress. The Earned Value should be calculated on a periodic basis and included into the status report (e.g. ISD High Priority Projects Report) to senior management.	(a) The journal entries were submitted to Finance is expected to be completed in May 2015. (b) The Manager of Business Management will recommend Earned Value Analysis (EVA) to the Manager, Compliance for inclusion into the ISD Delivery Model. Since then, the Manager, Compliance has reported that EVA will be re-introduced to the ISD Delivery model, possibly by Q1 2016.	M	**COMPLETE** – Q4, 2015
Review of Project Management Controls on the NMS Update Project #2015-06 June 26, 2015	**5. Risk Management**			
	(a) For an effective risk assessment process, criteria for assessing and prioritizing risk should be clearly defined and documented and determining the probable impacts on the Project value. (b) Appropriate risk mitigation strategy is developed and recorded in the risk log relating to NERC CIP 5 requirements.	(a) The Manager of Business Management will recommend consideration of an enterprise risk management methodology to the Manager, Compliance for inclusion into the ISD Delivery Model. This has been under development and has been vetted with Internal Audit. [redacted]	M	**COMPLETE** – Q3, 2015 (a) The Enterprise Risk Management methodology is now considered for every project and implemented when deemed necessary.

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		[redacted]		
Construction Services – Job Safety Planning And Workplace Safety Observations #2015-07 July 17, 2015	**2.1 Job Safety Planning Training**			
	Investigate opportunities to improve the quality of training materials for job safety planning training.	ACM Safety to convene a meeting of Construction Job Safety Planning trainers to review and align training materials and develop real-life scenarios to enhance the effectiveness of the training.	M	**COMPLETE** – Q3, 2015 Reinforcement completed with staff meeting.
Construction Services – Job Safety Planning And Workplace Safety Observations #2015-07 July 17, 2015	**2.2 Job Safety Planning Training**			
	Ensure that individuals who complete job plans are appropriately trained (SJOBPC).	Construction Services Management to verify that all training records for completed SJOBPC are input into the Learning Management System and ensure that individuals who complete job plans are appropriately trained. All Construction employees have completed SJOBPC training in the past three months during the Q1-2015 Safety Roll Out.	M	**COMPLETE** – Q3, 2015 Staff have taken the relevant training courses.
Construction Services – Job Safety Planning And Workplace Safety	**3.1 Job Safety Planning Execution**			
	Ensure that their expectations for Job Safety Planning and Tailboard Conferences are clearly understood and	Simplify and re-write SP 0140 R8 in a way that focuses on the JSP process (including a process flow–map) and management's expectations for the	M	**COMPLETE** – Q3, 2015 Re-write completed.

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Observations #2015-07 July 17, 2015	implemented by all employees involved in the process, through the Job Planning training course and the annual Construction Services Safety Roll-out.	process.		
Construction Services – Job Safety Planning And Workplace Safety Observations #2015-07 July 17, 2015	**3.4 Job Safety Planning Execution – Job Planning Tools**			
	Examine the current level of scrutiny applied to Job Safety Planning documents and determine if there is a need for increasing it, by giving consideration to: • The findings of this audit, • The findings of the annual reviews, and • The frequency applied by other LoBs.	Add section in WSO form to require review of a sample of previously completed Tailboard Sheets, provide feedback, and enter corrective action into WSO Action Tracker.		**COMPLETE** – Q4, 2015 WSO form updated, new process rolled out.
Construction Services – Job Safety Planning And Workplace Safety Observations #2015-07 July 17, 2015	**3.5 Job Safety Planning Execution – Other Work Groups**			
	Reinforce with all on-site supervisors the need to review Job Plans with all other work groups that are on site and the requirement to sign each other's Job Plans (tailboard).	Reinforce existing expectations with all workers to communicate with other work groups at the September roll outs.		**COMPLETE** – Q4, 2015 Messaging rolled out to staff.
Construction Services – Job Safety Planning And Workplace	**4.3 Workplace Safety Observation Execution**			
	(a) Reinforce the expectation with Superintendents and Managers that WSOs need	(a) Review the results of this audit with all Construction Managers and Supervisors reinforcing		**COMPLETE** – Q3, 2015 (a) Changes to our WSO process, especially around coaching those

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Safety Observations #2015-07 July 17, 2015	to be thorough enough to verify conformance with all safety requirements, reinforce positive behaviours, and correct improper behaviours. (b) Implement measures to enhance critical skills of WSO Inspectors.	expectations for WSOs. (b) Develop and deliver training package for Construction WSOs.		conducting WSO's and clear expectations have been completed. **COMPLETE – Q3, 2015** (b) Changes to our WSO process have been completed.
Audit of ISD Major Project Processes and Controls #2015-08 July 08, 2015	**1. Governance**			
	Clarify roles and accountabilities of groups working on the Project Delivery Model.	The Project Governance (PG) and Project Management Office (PMO) managers to provide summary of accountabilities associated with their respective roles.	M	**COMPLETE** – Q3, 2015 Documents created outlining the accountabilities associated with the respective roles of the PG and PMO managers in Corporate Projects. This is also reinforced by the fact that work across the two teams is coordinated to ensure effort is driven towards common goals.
Audit of ISD Major Project Processes and Controls #2015-08 July 08, 2015	**2. Project Delivery Model**			
	(a) Assess the coverage of the model and ensure all critical processes are included. (b) Create a work plan to add more detail in existing documents to clarify key control points. (c) Standardize all templates, tools, forms, and reports used on projects and provided to projects by	Will produce a plan documenting the approach to managing the following items: - identify gaps/inefficiencies in project delivery model coverage. - add detail and definitions to existing documents where needed. - standardize, templates, forms, reports, etc. to reinforce consistency. - define mandatory documents for projects.	M	**COMPLETE** – Q1, 2016

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	Project Support Services. (d) Clearly define which documents are mandatory. (e) Define how Project Managers can scale the methodology based on project size and complexity. (f) Utilize more collaboration in developing and updating processes and tools.	- provide guidelines for PMs on scalability. - extend reach across stakeholders for essential feedback. - provide training where needed.		
Audit of ISD Major Project Processes and Controls #2015-08 July 08, 2015	**3. Central Repository**			
	Re-organize the ISD website to make it easier to find and understand all the components of the Project Delivery Model and related tools.	All documents related to the project delivery model will be consolidated into one site. Also, the content will be organized in a logical manner to enhance search capability. The end result will be in compliance with ECM (Enterprise Content Management).	M	**COMPLETE** – Q4, 2015
Audit of ISD Major Project Processes and Controls #2015-08 July 08, 2015	**4. Quality Assurance**			
	Develop and implement a Quality Assurance (QA) program.	Frequent mini-audits will be performed on the project-specific sites to ensure appropriate content and usage. Also, these activities support the Plan-Do-Check-Act (PDCA) cycle and continuous improvement. The QA mechanism will be in-play by Q4-2015.	M	**COMPLETE** – Q4, 2015 The components that make-up the project governance QA program are now in-place to ensure compliance with the governance framework. Training and support for PMs is ongoing, and monitoring compliance will occur in SharePoint and by attending stage gate review meetings.
Conservation &	**1.0 Rationalizing verification and audit requirements with the IESO**			

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Demand Management Process & Operational Controls #2015-11 July 15, 2015	Under the CFF, the cost of documentary compliance should not exceed the value of incentives being delivered. Hydro One's CDM team should negotiate with the IESO to ensure that audit and verification requirements are practical, reducing the need to request numerous waivers or special exemptions. If absolutely necessary, provisions should be in place for the IESO to issue waivers where warranted by individual circumstances. The CDM team should further negotiate field inspection audit requirements with the IESO to ensure only reasonable numbers of samples are selected for testing, and to account for the Company's geographically dispersed territory.	The LDC/IESO working groups are currently in discussions and negotiations to review all Quality Assurance/Quality Control requirements for various CDM programs. The objective of the review is to propose changes that will better align the level of QA/QC requirements with the dollar value of the incentive provided to customers for individual projects.		**COMPLETE** – Q3, 2016 The new EM & V Rules were approved by the Business Working Group. The Rules became effective and operational June 20th, 2016. The rules reduce the amount of scrutiny and customer burden to demonstrate energy savings for small energy efficiency projects under the Retrofit CDM program.
Conservation & Demand Management Process & Operational Controls #2015-11 July 15, 2015	**7.0 Fully leverage available and cost effective media channels**			
	Ensure that the CDM website pages are updated with sufficient frequency to keep information up to date and current. Prepare a calendar of 'best before dates' for information that is expected to	We will review all CDM website content and link integrity. We will also create a best before calendar.		**COMPLETE** – Q4, 2015 CDM Website has undergone complete review and changes made accordingly. Calendar of events also completed and updated regularly.

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	become stale at a known point in time – both on the CDM website, and in the KMS.			
Corporate Technical Standards #2015-13 January 14, 2016	**1.1 Value of Corporate Standards**			
	Determine and document the expected value of Corporate Technical Standards in support of the stated Corporate objectives, and then develop and communicate strategies that will extract the best value using the CSDP. Perform a formal risk assessment as per ERM Policy (SP0736) on an annual basis to ensure that business risks related to the execution of these strategies are identified and mitigating actions are developed and tracked. Existing policies, processes, procedures, guidelines and training should then be revised in a timely manner, in sufficient detail and with appropriate stakeholdering to support these strategies.	(a) Corporate Standards will work on a Hydro One Standardization Strategy documenting expected value from standards and aligning with best utility practices. (b) Corporate Standards will conduct a risk assessment as per ERM Policy SP0736 to identify business risks related to the execution of these strategies, and mitigating actions will be identified. If required, existing processes and guidelines will be revised.	H	**ONGOING** In progress.
Corporate Technical Standards #2015-13 January 14, 2016	**1.2 Corporate Standard Improvement Initiative**			
	1.2 Obtain a formal approval of the Corporate Standard Improvement Initiative. Select and prioritize approved	1.2 VP Planning will ensure the standards program gets fully delivered. Categorization of taxonomy will be part of the overall	H	**COMPLETE** – Q1, 2016 The draft standardization strategy document has been completed and in the process of being reviewed. The Standards

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	initiative improvements for implementation. Improvements related to Standards Taxonomy should be given priority as they will help identify and prioritize missing standards, standards requiring revision as well as obsolete standards that should be cancelled and archived. The Standard Taxonomy will define functions and relationships among all standards. It will also identify precedent standards needed for the technical standards.	standardization strategy. The strategy will be stakeholdered as part of the recommendation in 1.1.		Taxonomy is documented as part of the strategy document.
Corporate Technical Standards #2015-13 January 14, 2016	**1.3 Accountabilities**			
	1.3 Clarify, document and communicate roles, accountabilities and authorities of the Corporate Standards group as well as principal authors and their management in the executing lines of business. This should include an overall governance authority that is able to facilitate and resolve technical issues among stakeholders as well as direct all stakeholders for successful completion of the annual work program.	1.3 The Director of Planning & Optimization will host a Standards Workshop to clearly define roles, accountabilities, and authorities to achieve alignment at the director level among all the LoBs.	H	**COMPLETE** – Q1, 2016 Standards Workshop has been completed. RASCI chart established and stakeholdered to define roles and responsibilities.

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Corporate Technical Standards #2015-13 January 14, 2016	**1.4 Funding for Standards development**			
	1.4 Identify and consolidate all OM&A and Capital funding for standards development to the CSDP so that all standards related work (including material specifications) is planned, prioritized, funded and monitored through Corporate Standards in an integrated and collaborative manner.	1.4 Corporate Standards will work with planning and executing LoBs to identify and consolidate management of funding from various sources for standards development, with project exceptions. This will be a topic of discussion at the Standards Workshop identified in recommendation 1.3.	M	**COMPLETE** – Q2, 2016 Communications with the planning and execution groups are complete. Applicable standard developments will be capitalized.
Corporate Technical Standards #2015-13 January 14, 2016	**1.5 Process and Tools Training**			
	1.5 Formalize and track all process and tool related training being given to stakeholders in their Learning Management System. Establish refresher training requirements and process change management whenever there are significant changes in process and tools. Priority should be given for the incomplete 2015 refresher training.	1.5 (a) Corporate Standards will develop a checklist and update any related procedures for Principal Authors to address deliverables at specific milestones. 1.5 (b) The Learning Management System will not be used for refresher training for Principal Authors. Initial training will be provided through LoBs department meetings using documented material to address the new processes and requirements. Documented training material will be retained and reviewed and updated on a periodic basis.	M	**COMPLETE** – Q2, 2016 (a) A checklist has been developed with specific milestones identified for the Principal Authors. (b) Initial training has started with Engineering, specific on Corporate Standards and External Standards search capabilities. Subsequent training will be offered to different LoBs on the new processes and requirements.

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Corporate Technical Standards #2015-13 January 14, 2016	**1.6 Lessons Learned**			
	1.6 Document and communicate lessons learned and use them for continuous improvement of the CSDP process.	1.6 Corporate Standards will implement a process to document and communicate lessons learned. Process to be aligned with action plans for recommendation 6.2 and 6.3. Primes from each LoB will be assigned to help assist in issues resolutions, lessons learned, and in-year changes that may impact other stakeholders.	M	**COMPLETE** – Q2, 2016 Lessons learned will be documented and communicated to all the LoB Primes at the scheduled monthly meetings. It will also be incorporated as part of the At-A-Glance Report sent on a monthly basis to senior management.
Corporate Technical Standards #2015-13 January 14, 2016	**2.1 Need Identification**			
	2.1 The scope and business need for requested technical standards are often unclear or incomplete. The current CSDP is primarily driven by Subject Matter Experts requests for various standards with inconsistent documentation of business need (risk/benefit), scope and requested priority.	2.1 Corporate Standards will revise the need identification form (i.e., CSPL) to include clear identification needs, justification related to Corporate justification, cost, schedule, resource requirements. CS will assess the needs and assign priority for action based on business justification.	H	**COMPLETE** – Q1, 2016
Corporate Technical Standards #2015-13 January 14, 2016	**2.2 Prioritization of Needs**			
	2.2 Develop detailed prioritization criteria and guidelines for applying the criteria for a funding and resource optimized standard program that is synchronized with other work programs driven by the Investment Plan and Sourcing Plan. Existing	2.2 Corporate Standards will develop and document prioritization criteria and guidelines for applying these criteria.	H	**COMPLETE** – Q1, 2016 The prioritization and guidelines are documented in our standardization strategy document.

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	needs should be assessed against the prioritization criteria. The prioritization criteria should include urgent need prioritization and redirection within the approved CSDP.			
Corporate Technical Standards #2015-13 January 14, 2016	**2.3 Interim Standards**			
	Clarify and document a procedure for development of future "interim standards". The procedure should identify when "interim standards" should be considered, how their development is to be funded, whether they should be fully stakeholdered and published in the standards library and how soon they will need to be replaced by sufficiently detailed and stakeholdered technical standard.	Corporate Standards will address urgently required Standards, as well as Standards that cost less than $15k to produce with a simpler process. The term "Interim standards" will no longer be part of Corporate Standards' taxonomy. This excludes any "interims" produced by Technical Services Lines department which is required to comply with REG 22.04		**COMPLETE** – Q1, 2016 Interim standards no longer accepted.
Corporate Technical Standards #2015-13 January 14, 2016	**3.1 Commitment to CSDP**			
	Implement a formal sign-off for CSDP commitments by executing LoBs. This will ensure that the management of executing LoBs will perform an adequate review of the work program for resource requirements and executability	Corporate Standards will implement a formal sign-off from executing LoBs to confirm agreement / commitment with their respective contribution to the annual CS Program.		**COMPLETE** – Q1, 2016 All directors' email approval received.

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	before committing to it.			
Corporate Technical Standards #2015-13 January 14, 2016	**3.2 Project Plan Details**			
	Ensure that an appropriately detailed project plan is developed which details scope, cost, schedule, quality and risks so that progress of work can be appropriately tracked and a Standard Variance Change Notice (SVCN) can be submitted and approved in a timely fashion as required. The cost of time spent by staff on fixed distribution should also be tracked or estimated.	Corporate Standards will monitor the cost and schedule of all the in progress work for each LoB, and also track the spending for each LoB. A SVCN will be required if the LoB exceeds 5% of the LoB's spending budget (AR level) or any schedule delay by one month or more.	M	**COMPLETE** – Q1, 2016 Cost will be tracked at the LoB's spending budget level, with a 5% variance allowance.
Corporate Technical Standards #2015-13 January 14, 2016	**3.3 Precedent Standards**			
	Ensure that related precedent standards are available as per standards taxonomy and appropriate resources are committed prior to starting work.	Corporate Standards will approve a project plan based on an established set of criteria which may include identification of precedent standard/functional requirements, resource commitment and concurrence from affected LoB.	M	**COMPLETE** – Q1, 2016 A set of criteria has been documented as part of our new Strategy document. This has also been clearly communicated to all LoBs including all Directors at the beginning of the year. Concurrence on standards development has also been established between all LoBs at an initial meeting attended by all Primes.
Corporate Technical Standards #2015-13 January 14, 2016	**3.4 CSDP Monitoring and Control**			
	3.4 Improve the existing monitoring and control over the CSDP by ensuring that: • an issue log is maintained	3.4 Corporate Standards will document issues raised during the standard development inclusive of the monthly progress reporting along with	M	**COMPLETE** – Q1, 2016 An issues log will be kept as part of the AAG report to document any issues and action plans discussed during the monthly

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	along with decisions and assigned actions so that issues raised during monthly progress reporting are resolved or escalated in a timely fashion • the SVCNs are submitted and approved in a timely fashion	decisions, assigned actions and completion dates. CS will also ensure that SVCNs are submitted and approved as per agreed process.		meeting with all the LoB Primes.
Corporate Technical Standards #2015-13 January 14, 2016	**4.1 Stakeholdering and Issue Resolution**			
	Review and revise the stakeholdering process to resolve the existing stakeholder issues as described in the observation.	(a) CS will review and revise the existing stakeholder process to address the issues observed. (b) Stakeholdering and issue resolution will be done by Principle Author and LOB Standards Primes with appropriate escalation to CS if needed.	H	**COMPLETE** – Q2, 2016 (a) Stakeholdering process is communicated. (b) Monthly issue resolution meetings have been established.
Corporate Technical Standards #2015-13 January 14, 2016	**4.2 Management Committee**			
	Establish a single Management Committee that includes appropriate managers from Corporate Standards and executing LoBs to discuss and resolve the stakeholdering process related issues as well as technical issues that prevent approval of a final standard. This forum should have a clearly defined mandate and authority to triage issues based on consistent information from available program reports and to make and implement	(a) CS will establish regular meetings with the Primes from all LoBs to address any outstanding issues. (b) The responsibilities and accountabilities for the different types of Standards will be addressed in a RACI chart. This information will be provided at the initial training.	H	**COMPLETE** – Q1, 2016 (a) Monthly meetings are scheduled. (b) RACI has been documented and stakeholdered.

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	consensus based decisions that are consistent with Corporate objectives.			
Corporate Technical Standards #2015-13 January 14, 2016	**5.1 Review and Approval Authorities for Standards**			
	Ensure that appropriate review and approval authorities are established for each standard beyond the Principal Author's group. Approval authority should include expected users of the standard as well as Corporate Standards to confirm that it meets traceability requirements and quality expectations.	CS will establish approval authority at the Director level for all standards from the Principal Author, and Corporate Standards, after establishing full agreement from all stakeholders involved with the standard.	M	**COMPLETE** – Q1, 2016 Established LoB Director sign-off as well as Corporate Standards Director sign-off on all approved standards.
Corporate Technical Standards #2015-13 January 14, 2016	**5.2 Standards Review Cycles**			
	Establish a consistent review cycle for standards so that only relevant and up-to-date standards are available to users. Appropriate review cycles could be established based on the types of standard, discipline, asset, etc.	CS will establish a review cycle for each new standard and will revisit and review existing standards for consistent review,	M	**ONGOING** Updates are being reviewed.
Corporate Technical Standards #2015-13 January 14, 2016	**5.3 Revision Guidelines**			
	Establish clear guidelines about what can be considered as a "major" or "minor" revision to an existing standard.	CS will revise existing guidelines to clarify what can be classified as a minor revision.	M	**COMPLETE** – Q1, 2016

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Corporate Technical Standards #2015-13 January 14, 2016	**6.1 Referencing of Standards**			
	Establish the need to reference standards being applied in plans, designs, specification, etc. If there are any exceptions, the reason for the exception should be clearly documented by the LOBs that used the standard.	CS will establish standard usage guidelines for standard application and monitor their use.	H	**ONGOING** Updates being coordinated with other LOBs.
Corporate Technical Standards #2015-13 January 14, 2016	**6.2 Measures for Value and Effective Use**			
	Establish metrics to measure value and effective use for each standard. These metrics can be used to prioritize revision of standards with widely used or key value standards getting priority for review and revision.	CS will develop and implement metrics to measure value and effectiveness of standards.	M	**ONGOING** Scheduled for later in 2016.
Corporate Technical Standards #2015-13 January 14, 2016	**6.3 User Feedback**			
	Develop and implement a process to solicit user feedback on quality and applicability of standards. This feedback can then be used to create or revise standards.	CS will develop and implement a process to solicit user feedback on quality and applicability of standards as an input to standards planning. The process will include exception rules for application of standards.	M	**COMPLETE** – Q2, 2016
NERC CIP Version 5 Project Management Audit #2015-09 July 10, 2015	**1.1 Lack of a formal project methodology that is consistently utilized by Project Manager.**			
	The Hydro One Corporate Projects group should ensure that a repeatable methodology with structured processes for initiating, executing and closing	Corporate Projects assessed the Program Management team performance in September – November of 2014 and initiated changes in the project management team through to	H	**COMPLETE** – Q2, 2015 Corporate Project initiated changes in the project management team wherein, they are staffed with Corporate Project personnel that is familiar with the ISD

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NERC CIP Version 5 Project Management Audit Follow up Review #2015-16 October 15, 2015	projects be in place. This includes adherence with the ISD Project Delivery model (see Appendix D) which provides the suggested template for project documentation.	February 2015 and May 2015. A Program Office staffed with Corporate Projects resources was put in control of the NERC projects. The program office has readdressed the issues mentioned above and brought better control to the NERC project streams.		Project Delivery Model. The Director of Corporate Project facilitates the weekly team meeting to ensure that among others, the required deliverables in the ISD Project Delivery Model is adhered to.
NERC CIP Version 5 Project Management Audit #2015-09 July 10, 2015 NERC CIP Version 5 Project Management Audit Follow up Review #2015-16 October 15, 2015	**1.2 Roles and responsibilities are not clear and well understood within the project.**			
	Stakeholder's roles and responsibilities to manage delivery of the work should be defined, documented, and agreed upon by all stakeholders. This includes updating the project organizational chart and RACI chart to accurately depict the decision making and reporting hierarchy.	Project Management team replacement completed. RACI Matrix will be defined and published for each work stream to define clear ownership of deliverables.	M	**COMPLETE** – Q2, 2015 The revised Project Management team is working well with regular weekly meetings. The RACI is incorporated in the Project Charter.
NERC CIP Version 5 Project Management Audit #2015-09 July 10, 2015 NERC CIP Version 5 Project	**1.3 Lack of an overall NERC CIP subject matter advisor assigned to the project**			
	Management should assign an overall NERC CIP subject matter advisor that could provide additional assurance that potential gap in project requirements or scope are identified and remediated before the April 2016	The project is leveraging external NERC CIP subject matter advisors such as: External resources.	M	**COMPLETE** – Q3, 2015 Project Leadership and NERC CIP subject matter adviser identified.

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Management Audit Follow up Review #2015-16 October 15, 2015	compliance deadline. In addition, the subject matter advisor can advise project leadership over the sustainability of solution identified for NERC CIPv5.			
NERC CIP Version 5 Project Management Audit #2015-09 July 10, 2015 NERC CIP Version 5 Project Management Audit Follow up Review #2015-16 October 15, 2015	**2.1 An approved project charter is not in place and in use.**			
	Develop and finalize the project charter to provide the framework and methodology for managing and supporting the project. The project charter should contain the following information: - The project purpose or justification - Project objectives - The high level requirements - Project success criteria - Expected benefits, e.g. value realization - Summary of schedule and budget - Project approval requirement and approval authority.	The current Project Charter will be revised to more accurately reflect this project's objectives and outcomes. Whilst agreeing the importance of this documentation, this has taken a lower priority than getting the project planning and implementation under way.	M	**COMPLETE** – Q4, 2015 The Project Charter has been re-written, comments obtained and a final version will be circulated for approval in September. Delays were encountered due to requested comments by some stakeholders.
NERC CIP Version 5 Project Management Audit #2015-09 July 10, 2015	**2.2 A project management plan is not utilized.**			
	Develop a formal written document (project management plan) on how the project will be executed, monitored, and closed,	A project management plan will be created to integrate the individual work streams and provide direction for execution, monitoring and close-out upon project conclusion. An integrated	M	**COMPLETE** – Q2, 2015 The IPP is reviewed and managed weekly with PMs and Directors Each of the seven project "streams" have a project plan. Each project plan contains links to

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NERC CIP Version 5 Project Management Audit Follow up Review #2015-16 October 15, 2015	including all subsidiary management plans (e.g. scope, requirements, schedule, risk management, etc.).	project plan now exists to ensure interdependencies of work streams are being managed.		other plans where appropriate so that inter-dependencies are identified and tracked. The individual plans are reviewed weekly and consolidated into the overall IPP. Each Project Plan contains agreed KPI indicators that are used to identify and track the Project progress.
NERC CIP Version 5 Project Management Audit #2015-09 July 10, 2015 NERC CIP Version 5 Project Management Audit Follow up Review #2015-16 October 15, 2015	**2.3 The specific requirements necessary to implement NERC CIP v5 have not been vetted and approved by the stakeholders.**			
	Develop a requirements documentation that is clear, unambiguous (measurable & testable), traceable, and that is acceptable to key stakeholders. The requirements should also be mapped to the different work streams to provide clarity over the roles and responsibilities in the implementation of the NERC CIP requirement, including ownership of deliverables for each of the work streams.	A database has been created on the main project SharePoint page. This CIP Finder tool consists of a friendly user interface that references the NERC CIP requirements against Governing Delegate, Execution Delegate, Project Management, Subject Matter Expert owners. This application will also match requirements to evidence documentation as the project completes its tasks. This tool will allow for traceability of execution against requirements and it will also simply traceability for audit purposes.	H	**COMPLETE** – Q3, 2015 The CIP Finder has proved to be a valuable tool to identify the Project requirements and ownership. The tool has been extended to incorporate compliance evidence planned dates and has become the official list of stations/facilities which are the subject of the Project. Monitoring of this subject will continue to the end of the Project.
NERC CIP Version 5 Project Management Audit #2015-09 July 10, 2015	**3.1 The scope of the project should be vetted and verified with key stakeholders.**			
	We recommend the following: - Define and verify the scope of the project with the key stakeholders. - The delivery accountability for each work streams should be	The project team is now in the process of rolling out the NERC CIP finder tools to the key stakeholders to educate them on their accountabilities to meet the requirements. We will get the Governing Delegate's and Execution	H	**COMPLETE** – Q3, 2015 The CIP Finder has proved to be a valuable tool to identify the Project requirements and ownership. The tool has been extended to incorporate compliance evidence planned dates and has become

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
NERC CIP Version 5 Project Management Audit Follow up Review #2015-16 October 15, 2015	documented and approved.	Delegate's to review and signoff their requirements.		the official list of stations/facilities which are the subject of the Project. Monitoring of this subject will continue to the end of the Project.
NERC CIP Version 5 Project Management Audit #2015-09 July 10, 2015 NERC CIP Version 5 Project Management Audit Follow up Review #2015-16 October 15, 2015	**3.2 No adequate process to ensure that changes to the scope and WBS are controlled and assessed as to their implication to the overall schedule and budget.**			
	The changes to the scope and WBS should be handled through the Change Management processes: identification, evaluation, recommendation, approval, and incorporation.	The project scope assessment was part of the initial project work which resulted in the creation of the detailed full project estimates, which formed the basis of the board approval in May. In addition, a database of CIP requirements has been created which further clarifies the scope. Change Management process will be applied to requests in scope or changes to original WBS.	M	**COMPLETE** – Q2, 2015 The project scope is defined by the signed DARCS. No changes to the DARCS have been made, although a revised template is under review. A Change Management process is in place. Any schedule date change requires PMOLT approval.
NERC CIP Version 5 Project Management Audit #2015-09 July 10, 2015 NERC CIP Version 5 Project Management	**4.1 Key project milestones are not incorporated in the integrated project plan.**			
	We recommend that project milestone be included in the project charter, scope statement and Integrated Project Plan. Once milestone are identified, we recommend that a milestone list be created which can be used as an easy reference to all project	An Integrated Project Plan (IPP) has been created. Project milestones are being added to ensure overall program completeness. The IPP has been base lined to enable SPI and EV calculation.	H	**COMPLETE** – Q2, 2015 The IPP is reviewed and managed weekly by PMs and Directors. Milestones are incorporated in the IPP, as are KPIs.

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Audit Follow up Review #2015-16 October 15, 2015	stakeholders on what milestones are included in the project and when they will occur.			
NERC CIP Version 5 Project Management Audit #2015-09 July 10, 2015 NERC CIP Version 5 Project Management Audit Follow up Review #2015-16 October 15, 2015	**4.2 The Earned Value Performance Measures Should Be Utilized and Reported**			
	We recommend that the project management should utilize and report on Earned Value measures. The Earned Value should be calculated on a periodic basis and integrated into the status report (e.g. Project At-a-Glance) to senior management.	Earned Value is now being calculated and is to be included on the weekly "At-a-Glance" report.		**COMPLETE** – Q2, 2015 SPI, CPI and Earned Value are calculated monthly and included on the "At-a-Glance" report.
NERC CIP Version 5 Project Management Audit #2015-09 July 10, 2015 NERC CIP Version 5 Project Management Audit Follow up Review #2015-16 October 15, 2015	**7.1. Inconsistent reporting of project status.**			
	We recommend that project status should be reported consistently between what is reported to the team meetings, PMOLT and Tx Steering Committee meetings.	The example of the Tx Steering Committee status report was based on the qualitative assessment of the overall project health. This was necessary until the At-a-Glance report, which is based on quantitative calculations, was tuned and base lined. Now all reporting is driven from the base lined project plan. Project status is being communicated consistently now as a result of alignment between various reporting channels.		**COMPLETE** – Q2, 2015 Project status is being reported consistently, weekly. The deliverables of the Project are the evidence documentation for each CIP requirement as defined in the signed DARCS. These are contained in the CIP Finder database.

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NERC CIP Version 5 Project Management Audit #2015-09 July 10, 2015 NERC CIP Version 5 Project Management Audit Follow up Review #2015-16 October 15, 2015	**8.1 No defined approach in place over the acceptance of the project deliverables.**			
	Develop a deliverables acceptance document that defines the acceptance criteria and conditions that must be achieved before deliverables are accepted and approved. In addition, we recommend that the Project Management team ensure that Project Deliverable acceptance and approvals should be consistently documented and stored in the NERC CIP v5 SharePoint repository.	Project work stream deliverable templates are being developed to ensure specific compliance deliverables are being generated by the individual work streams. These will be contained in the CIP Finder database.	H	**COMPLETE** – Q2, 2015 These are contained in the CIP Finder database and regularly reviewed and managed by PMs and Directors.
Transmission Protection & Control #2015-17 November 6, 2015	**2.1 Resource Optimization**			
	Reassess the existing methodology for consistent optimization of resource allocation including a review of current approach to use available hiring hall resources and overtime to supplement resources as well as over-scheduling of work.	Station Services will reassess the existing resource allocation methodology for consistent application and effectiveness.	M	**COMPLETE** – Q1, 2016 Process has been reviewed and incorporated in 2017 business plan.
Transmission Protection & Control #2015-17 November 6,	**2.2 Temporary Resources**			
	Develop a plan to mitigate risks associated with the temporary resources being utilized for PCMIS and PSEA work.	PCTS will develop a strategy and plan to mitigate risk associated with reliance on temporary and contract staff.	H	**COMPLETE** – Q2, 2016 PSEA Plan has been developed.

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
2015				
Transmission Protection & Control #2015-17 November 6, 2015	**2.3 Work Acceptance and Prioritization**			
	(a) Station Services: Document and communicate clear work acceptance and prioritization criteria. Implement a change control log (or other suitable mechanism to capture change details in a single repository) to keep track of specific work that has been added/removed/revised from the annual work program. This recommendation aligns with management actions (Planning and Project Management) associated with recommendations 5 and 6 from the Asset Deployment Audit. (b) PCTS: Document and communicate clear work acceptance and prioritization criteria. Implement a change control log (or other suitable mechanism to capture change details in a single repository) to keep track of specific work that has been added/removed/revised from the annual work program. This	(a) Station Services will document and communicate work acceptance and prioritization criteria and investigate feasibility of a change control log to capture changes to the work program. (b) PCTS will define and document work acceptance, prioritization and change management process.		**COMPLETE** – Q4, 2015 (a) Process has been finalized with E&CS. (b) Detailed process has been developed.

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	recommendation aligns with management actions (Planning and Project Management) associated with recommendations 5 and 6 from the Asset Deployment Audit.			
Transmission Protection & Control #2015-17 November 6, 2015	**3.1 Extra Work Claims**			
	Ensure that the submitted and approved EWC documents are centrally stored to enable tracking of approval and subsequent changes to cost and schedule. Reinforce requirement for consistent use of EWC process.	SS will ensure that each zone will store centrally all EWC's. Process reinforcement will be communicated through Superintendents and ECS.		**COMPLETE** – Q2, 2016 Process review and reinforcement has been completed.
Transmission Protection & Control #2015-17 November 6, 2015	**3.2 Missing Information Tracking**			
	Track and alert stakeholders in cases where missing information (such as drawings, protection settings, instructions, standards, etc.) required to commence P&C work related to capital project commissioning.	Station Services will work to identify input requirements early to Planning, Engineering and Project Management and escalate unaddressed items with high risk impacts within SS though Senior P&C Engineers or Supervisors		**COMPLETE** – Q1, 2016 Station Services is now a partner in the new estimating process and project planning.
Transmission Protection & Control #2015-17 November 6, 2015	**4.1 Quality Assurance Program**			
	Review and implement a quality assurance program that verifies on a sample basis that all tasks were completed as per instructions and specifications provided in the approved	Stations will review what North American Transmission Forum (NATF) best practices are and implement where possible. [Due date is for review - Implementation TBD]		**COMPLETE** – Q2, 2016 NATF has been contacted without any response.

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	procedures.			
Transmission Protection & Control #2015-17 November 6, 2015	**4.2 Corrective Work Orders**			
	Ensure that Corrective Work Orders are assigned correct priority and that the work is completed in accordance with the assigned priority.	Stations Services has recently reissued DR report with appropriate clarification of accountabilities and training to ensure corrective work will be assigned correct priority for completion. The DR report will be monitored for improvement.	M	**COMPLETE** – Q4, 2015 Rolled out report and identified accountabilities including ensuring correct priority.
Transmission Protection & Control #2015-17 November 6, 2015	**5.1 MIFORM Reports**			
	Ensure that MIFORM reports of sufficient quality are submitted within a reasonable time after completion of field work.	SS will continue to monitor MIFORM completion performance and supplement with trending and aging information.	M	**COMPLETE** – Q4, 2015 MIFORM Quality monitoring is in place.
Transmission Protection & Control #2015-17 November 6, 2015	**5.3 Maintenance Workbook Audit**			
	Evaluate results of the on-going regulatory maintenance workbook audit to provide: a. further training to field staff on root causes of errors. b. consideration to performing this audit on a sample basis rather than for all items.	SS will evaluate root cause of workbook audit failures and take corrective actions. PCTS will review the current requirement of auditing each workbook.	M	**COMPLETE** – Q1, 2016 Workbooks have been revised so that they can't be saved if validation has failed.
Audit of Clarington Project –Review of Project Management Controls	**1.1 Governance Controls - Project Partners Roles and Accountabilities Documentation**			
	The documentation of roles and accountabilities for this project is critical due to the deficiencies identified at the Organization level in observation # 3	Project Management agrees to revise an organization chart to reflect roles and responsibilities, reporting lines and issue escalation channels of various project teams involved.	M	**COMPLETE** – Q1,2016 - A project organization chart has been finalized that includes lead contacts for both internal and external project stakeholders and leads

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#2015-18 December 10, 2015	"Alignment between various LOBs" in the Audit of "Construction Project Management Processes". Project Management should clearly document roles and responsibilities, reporting lines and issue escalation channels of the various project teams involved.			- The main communication contacts for the project have also been identified and delineated - Reporting lines and escalation channels are included to ensure project stakeholders are aware of SPOC's for the applicable project area - All parties listed in the communication chart have received a copy of the project org chart.
Audit of Clarington Project –Review of Project Management Controls #2015-18 December 10, 2015	**1.2 No Consolidated Issue Tracking and Escalation Process**			
	We recommend that Project Management clearly define, document and implement an issue escalation process for the project. This should include the following elements/activities: • Definition of the types of issues needed to be identified and documented at project team level. • Develop and utilize a centralized issue log (running list of issues) • Accountability for each level responsible for either resolving or escalating issue to next higher level should be identified and communicated. • Issue Resolution target time for each level should be	i- Although the escalation process is well understood and is being followed, the documenting of this would bring clarity and also enable clear direction should issues arise which require immediate escalation beyond direct manager/supervisor. ii- The PM will be provided with guidance to develop and implement a consolidated issue log which will provide tracking for all the project issues resolved or still pending for the remaining project period.		**COMPLETE** – Q1,2016 - The Project Manager maintains a database of meeting minutes that contains action items which serve as the issues tracking for the project - The Project Risk Management Plan identified and outlined the various potential risk items related to the Project. These issues are tracked/monitored and are escalated for resolution as required.

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	determined and monitored.			
Audit of Clarington Project –Review of Project Management Controls #2015-18 December 10, 2015	**1.3 Absence of project controls and processes documentation.**			
	To ensure consistency and effective monitoring, the Project's Management needs to define and document the scope, cost and schedule management controls and procedures implemented throughout the project life cycle. *Note:* The need for defining and documenting the scope, cost and schedule control system for this project exists due to the absence of project management methodology at the Organization level as identified in Observation #1 of our Internal Audit of "Construction Projects Management Processes".	The Project's Management will document the controls and procedures followed for managing the project cost, schedule and scope to ensure consistency.		Behind schedule. New completion date is Q1, 2017. Standard draft PEP project template has been developed and is being stakeholdered with various senior PM's to solicit feedback. Standardized Project Management SharePoint site has been created that will act as a Project library storing a standard set of project-related documents that the Project Manager has control and ownership. ofhttps://teams.hydroone.com/sites/ecs/pm/SitePages/Project_Documents.aspx A draft Project Management methodology report from Burns and MacDonnell has been developed as of April 1, 2016. Future Action • By the end of April 2016, a transition plan will be finalized and rolled-out for full implementation of the Project Execution Plan to assess and decide on how to proceed with the recommendations provided.
Audit of	**2.1 Document Management - Restricted availability to project documentation**			

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Clarington Project –Review of Project Management Controls #2015-18 December 10, 2015	The Project Management should develop a dedicated SharePoint site for the project and all the critical project documents are saved on that central location to ensure the availability and accessibility of related project documents to all the team members as appropriate.	Work Program Management will allocate a space for the Clarington Project on an existing Construction Services SharePoint and will ensure that all the Project documents are transferred to the dedicated SharePoint throughout the project lifecycle for reference and sharing among project team members and related stakeholders.		**COMPLETE** – , Q2, 2016 - A Share-point site already exists for the storage of project related documentation, however the navigation and search capabilities are poor. - A new approach to assist with the organization of this site has been defined, stakeholdered and approved - A Standardized project document share-point library for all top projects and programs has been put in place at end of Q1, 2016 - Training for all Project Managers on use of standard Project Share-point sites completed at the end of Q1, 2016 Future Action - As part of the initiatives with Burns and MacDonnell, we will be aligning our share-point sites with the methodology outlined in the document control PEP - Transitioning of all required key project documents into new SharePoint site to occur in Q2, 2016 'As part of the TX Capital Efficiency Initiatives, a project charter for the Document Management System improvement initiative was complete June 30, 2016. The charter addresses the ongoing needs of a centralized project document system as well as the overall site management for processes,

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				department records, and other common documents. The initiative will incorporate a comprehensive view of standardize project document requirements as defined in the (draft) PEP as well as feedback from the current Doc Mgmt System in place. These requirements and definitions for the Document Mgmt System will include Roles and Accountabilities as well as KPIs to monitor system use.
Audit of Clarington Project –Review of Project Management Controls #2015-18 December 10, 2015	**3.1 Contract Management - Lack of Contract Closeout Checklist**			
	The Project's Management should develop a contract closeout checklist that can be implemented at the contract completion phase. The checklist should include following essential activities such as: • Status of completion of deficiencies. • Final settlement of administrative and legal details. • Notice of Completion of contract • Release of hold back payments • Post Contract Performance Evaluation • Update Approved	There needs to be process documented for the contract and project closure that will include a checklist of essential activities which will be considered at the contract completion stage.		**COMPLETE** – Q1, 2016 - A contract checklist has been developed and is continually reviewed and updated at each relevant stage of construction. - All projects greater than $5M are also reviewed during the project closure process which includes a review and documentation of the contract portion of the project as well as any lessons learned Includes: - Form 16 (Notice of Completion) - Form 12B (Holdback) - Form 13 B (Deficiencies and non-conformance Log) - Form 17 (Post Contract Performance Evaluation) Future Action • Contract Management is exploring creating a Vendor of Record (VOR) for

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	Contractors List • Lessons learned discussion.			ePC/PC projects in the future. • Monitor to ensure Contract checklist and contract documentation associated are completed at the end of construction.
Audit of Clarington Project –Review of Project Management Controls #2015-18 December 10, 2015	**4. Schedule Management - Incomplete Project Schedule**			
	The Project's Management should finalize, document and sign-off a baseline schedule for the detailed project activities. Actual performance should be monitored against this baseline schedule and variances should be adequately explained in the monthly status reports	The Project's Management is working with other lines of business to finalize the planned start and end dates for detail project activities to be carried out by Hydro One. Besides high level schedule monitoring in Primavera 6, Project Management is developing detailed, resource loaded schedule in P6 for remaining work (Clarington Station construction by the contractor, Remotes Stations by Hydro One). The transition from MS Project Management to the new format in P6 is in progress and will be completed during the project period.	M	**COMPLETE** – Q1, 2016 - Project Schedule has been completed with a baseline that is detailed and comprehensive - A resource schedule is available in P6 which includes remotes work Future Action • Ensure schedules are updated on an ongoing basis to reflect achievement of milestones and any project information pertaining to potential impacts on timing and resourcing are reflected and communicated.
Audit of Clarington Project –Review of Project Management Controls #2015-18 December 10, 2015	**5.1 Cost Management – Discontinuation of Earned Value Reporting (EVR)**			
	We recommend that Management fully implement the EVR process and generate the regular EVR reports for all project activities to monitor the project performance throughout its lifecycle.	The Project was generating EVR for reporting to Steering Committee. However, due to a transition to the new program Primavera (P6), EVR was not generated for a period between May to September 2015. Clarington Project will be used as a pilot project for the generation of EVR through P6. It is intended that in coming months we	M	**COMPLETE** – Q1, 2016 - A more robust Earned value reporting methodology has been reintroduced is being produced monthly since October of 2015 Future Action • Ensure monthly EV reporting updates continue to be produced and published.

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
		will be able to resume generating earned value reports.		
Audit of Clarington Project –Review of Project Management Controls #2015-18 December 10, 2015	**5.2 Ineffective Cost Monitoring**			
	We recommend that Project Delivery provide directions to the PM to document detailed explanations for cost variances between actual vs. forecasted vs. budgeted costs in the Month End Reports.	Project Delivery will provide guidance and ensure that variances are explained in adequate detail for effective monitoring in the future Month End Reports		**COMPLETE** – Q4, 2016. - Variances are now fully explained in full detail as per the new VCN reporting process - Comprehensive VCN reporting training has been rolled out to all PM's to ensure detailed/consistent explanations are provided for all variances - Improved VCN process for date changes. Asset Management is now involved in this approval process. Agreed in-service changes are now officially updated in SAP. New VCN template was developed in August 2015 to facilitate this process. - On a quarterly basis, Decision Support provides oversight and performs a periodic review all investments to ensure all potential IROV's are identified and addressed with Asset Management for input to a report to the IRRC.
Audit of Clarington Project –Review of Project Management Controls #2015-18	**5.3 Management of Contingency Funds**			
	We recommend that in the absence of formal Hydro One prescriptive guidance providing direction on the proper use of contingency funds, the PM should be instructed to use contingency funds only for	Contingency management has been identified and whilst the contingency has not been specifically allocated to risk, we do follow a universal process across the Project Delivery group for contingency use i.e. documenting any use of contingency funds through		**COMPLETE** – Q1,2016 - Contingency is being released/reduced as the project completes its various phases and/or milestones and the forecast at completion is reflected accordingly - All Project Delivery Managers have been

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
December 10, 2015	those risks/occasions which have been forecasted and documented during the project approval process and in the event that a risk which has a contingency amount associated with it does not materialize, that the amount be extinguished and the total contingency be reduced accordingly	variance change notices (VCNs). These are approved in accordance with the authority limits provided in Organization Authority Register (OAR). However, Project Delivery Group will develop and provide guidance to the PM for the effective use of contingency funds only for the identified and approved risks and purposes. The use of contingency funds will be reported and monitored through regular project reports.		consulted to solicit feedback for a consistent approach to managing contingency and tying into identified risks - New EAR's have been established for VCN's and IROV's to expedite the processing and turnaround times for processing. - Directors are now responsible for approving the use of contingency through VCN's(50%) - Asset Management is now also required to approve changes to in-service dates - We improved upon the existing use of contingency by adding in consistent guidelines on the use of contingency as well as standard documentation on contingency thresholds and drawdown. This has been stakeholdered with directors and will be rolled out by the end of April, 2016 Future Action • Finalize recommendation for a portfolio wide approach to management of contingency Burns and MacDonnell reviewing project contingency use and will be providing a recommendation on best practice.
Audit of Spill Management #2015-19 December 8,	**2.0 Station-Specific Emergency Response Plan Documentation**			
	Ensure the required updates to the outstanding Site Drainage drawings are completed,	Engineering has prioritized this work and continues to make further progress. All required updates to		**COMPLETE** – Q2, 2016

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
2015	included into the respective HODS version of the ERP, and issued to the field for insertion into the local Station copy.	outstanding ERP Site Drainage drawings will be completed, sent to HODS for posting, and the updated drawings issued to the field for insertion into the local Station ERP binders.		
Audit of Interim Review of Variances #2015-20 December 11, 2015	**1. Accountability to Submit IROVs**			
	We recommend that management: 1. Review the IROV policy to ensure that it is written in a clear manner that defines the obligation of each line of business to submit IROVs when any of the IROV criteria have been met. 2. Establish rules regarding automatic project approved amounts based on the occurrence of a specified event. 3. Ensure that each line of business has a clear process for following the IROV policy, including a responsible representative within that line of business. 4. Identify on a regular basis all projects meeting IROV cost and schedule variance criteria in PP-190 or such other report that management feels is	We will review and update the IROV Procedure and form to clarify: 1. Accountabilities 2. Timelines for initiation 3. IROV triggers 4. Information Requirements 5. LOB Roles 6. Compliance Monitoring process		**COMPLETE** – Q4,2015 Item complete all actions addressed in revised and approved new IROV procedure

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	reliable. 5. Require lines of business to submit regular reports identifying projects that are being prepared for IROV submissions. 6. Establish a non-compliance report identifying those projects for which IROVs are not submitted on time, or have not been submitted at all.			
Audit of Interim Review of Variances #2015-20 December 11, 2015	**2. Submission of IROVs in a Timely Manner**			
	We recommend that management: 1. Comply with the requirements of the IROV Policy. 2. Provide greater guidance to determine when a Schedule Variance has occurred. The IROV reporting form should contain a checklist or process that is designed to determine whether a significant and business impactive change has occurred to the planned In-Service date. 3. Ensure that IROVs are submitted and approved on a timely basis. 4. Prescribe an outside date within which the IROV	We will review and update the IROV Procedure and form to clarify: 1. Accountabilities 2. Timelines for initiation 3. IROV triggers 4. Information Requirements 5. LOB Roles 6. Compliance Monitoring process	M	**COMPLETE** – Q4, 2015 Action Plan complete all items addressed, new procedure approved

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	process must be commenced once any of the criteria for IROVs are met. 5. Review the practice of LoBs operating outside the IROV Policy process to agree to in-service dates, and either formally approve or disapprove the practice. 6. Clarify in the IROV Policy whether projects that Hydro One does not have sole control over, such as customer projects, are to be treated differently for purposes of application of the Policy.			
Audit of Interim Review of Variances #2015-20 December 11, 2015	**3. Quality of Information in IROV Submissions**			
	1. The IROV form should be revised to indicate the following information in a clear manner: a. Earliest date any of the requirements for IROV was triggered. b. Amount spent to-date. c. Earned value calculations as of the date of the IROV submission. 2. Detailed explanation, including root cause, of each of the following, discussed separately:	We will review and update the IROV Procedure and form to clarify: 1. Accountabilities 2. Timelines for initiation 3. IROV triggers 4. Information Requirements 5. LOB Roles 6. Compliance Monitoring process		**COMPLETE** – Q4, 2015.

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	a. cost b. schedule c. scope 3. A certification from the person preparing the form that they have included all pertinent information in the form, or attached appropriate documents to the IROV form, and that the IROV request presents fairly and accurately the Variance Explanation and the Lessons Learned. The IROV form should indicate on its face the name of any documents appended to the IROV form. 4. A certification from the approver indicating that they have: a. Reviewed the IROV request, b. Sought out the appropriate clarifications and made any necessary inquiries on matters relating to the subject IROV prior to their approval. 5. If the IROV explanation attributes a root cause issue relating to another department within Hydro			

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	One, there should be a sign-off on the face of the IROV that the other department has reviewed the IROV and agrees with the statements made. 6. IROV form routing should have time limits to approve or decline to approve, so that IROVs are processed in a timely manner. 7. The IROV form and process should require that variance cost estimates be based on realistic estimates rather than worst case numbers.			
Audit of Interim Review of Variances #2015-20 December 11, 2015	4. **Appropriateness of Approvals**			
	Management should ensure: 1. The time gap between the IROV submission date and the approval date is minimized. 2. That all IROV forms are completed in a clear and accurate manner, and include the name, title, and department of each reviewer and approver.	We will work with Internal Control, to review OAR /EAR Policy to; a. Reconfirm appropriateness of IROV approvals and b. Ensure completeness of the Policy for Projects, Programs and Station Centric work		**COMPLETE** – Q4, 2015
Audit of Interim	5. **Monitoring Process to Support Compliance**			

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
Review of Variances #2015-20 December 11, 2015	We recommend that management: 1. Designate the Corporate Planning and Financial Support group be the central Hydro One authority to ensure compliance by lines of business with the IROV Policy. 2. Introduce further controls to prevent lines of business from incurring additional costs without an approved IROV or additional BCS. 3. Designate the PP-190 report, or such other report that it deems appropriate, as the main source for data to determine whether variance thresholds have been triggered under the IROV Policy.	1. We will review and update the IROV Procedure and form to clarify; a. Accountabilities b. Timelines for initiation c. IROV triggers d. Information Requirements e. LOB Roles f. Compliance Monitoring process 2. Create and implement a plan to introduce compliance monitoring of the IROV procedure across all applicable LOBs	H	**COMPLETE** – Q4, 2015.
Below Grade Construction Activities #2015–24 January 15, 2016	**1.0 Documented Process for Performing Locates within Transmission Stations**			
	Perform a critical review of the Locate process and establish a comprehensive procedure for performing Locates inside a Transmission Station, that addresses: • Accountabilities between Station Maintenance and Construction Services for	Perform critical review and update/develop the necessary process / procedure document(s).	M	**ONGOING** In the process of stakeholdering new locate process with other LOBs. Expect to complete by Q3 - 2016.

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	Locate requisitions, • Scope and accuracy of Locates, • Training and competency of internal resources performing Locates, • Standardization of Locate markings, • Requirements / triggers for Locate refreshes, • Locate documentation, • Locate requisition process and quality assurance.			
Below Grade Construction Activities #2015–24 January 15, 2016	**3.0 Training and Equipment**			
	Incorporate more comprehensive Transmission Station elements into the cable locating course.	Review and update cable locate training requirements with HSE's Training & Development group.	M	**ONGOING** Once documentation process is complete, the new process will be incorporated in the training program.
Below Grade Construction Activities #2015–24 January 15, 2016	**4.0 Monitoring and Reporting**			
	Review the incident reporting process to determine the reporting expectations with respect to contact with non-electrical services and near misses with all buried services, considering best practices implemented by Ontario Regional Common Ground Alliance (ORCGA) to ensure that the incident reporting expectations are clear.	Follow up with Health, Safety and Environment group on reporting expectations with respect to contact with non-electrical services and near-misses with all buried services. Construction Services will communicate these expectations to all Managers/Supervisors.	M	**ONGOING** Awaiting decision from H&SE group on reporting requirements.

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
Transmission Outage Management #2015–25 January 7, 2016	**1.0 Governance**			
	Establish a single accountability (owner) of the outage management function. This needs to be stated within a governance document that includes the objectives, rationale and organization to support the objective, components of the function (e.g. TSOG[1], CROP[2]) and how these processes work within the overall framework.	NOD will develop a policy document for the outage management function which will include the accountability (ownership of the outage management function), objectives, rationale, the Line of Business (LoB) stakeholder needed to support the objectives and how component processes (e.g. TSOG & CROP) function within the overall framework.	M	**ONGOING** The business will continue to review the outage process and look to create a governance document with priority settings. This can and will be aligned with the outage cancellation initiative.
Transmission Outage Management #2015–25	**2.0 Defined Process**			
	(a) There is no consistent overarching mechanism or guideline to prioritize outage requirements from multiple and competing business needs. For example, the current prioritization drop-down list in the Network Outage Management System	(a) Establish overarching prioritization guidelines for scheduling outages to drive a One Company approach rather than individual LoB accomplishment needs.	M	**ONGOING** Cancellation and cost reviews have taken place and a strategy in place. The plan is to present the proposal to senior management for approval by July 15th and implemented by Q3 – 2016.

[1] TSOG (Transmission System Outage Grouping). This is a Network Operating Division coordinated initiative that focusses on long range outage planning through the bundling of outage requests for the most efficient execution of capital and sustainment programs, coordination with transmission connected customers and taking into account forecasted bulk electric system conditions, system limits, operating constraints and minimizing impact on the security and reliability of the transmission system.

[2] CROP (Continuous Rolling Outage Process). This is an established Network Operating Division initiative that involves quarterly scheduling meetings with stakeholders to coordinate outage plans three months ahead.

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	(NOMS) is not of sufficient quality to aid a Controller to make a proper decision as to which outage to cancel.			
	(b) There is no job specific outage planning training for outage planners (e.g. Operating Planning (OP) department Network Management Officers (NMOs) and Controllers). Instead, they are dependent upon job shadowing and one on one mentoring. The overall outage management function is reasonably effective, but the lack of training results in challenges and inconsistencies in training new staff into the role. There are continuous challenges in attracting and retaining outage planners within OP. NOD is actively managing this through supplementing resources with 5 control room rotators on an on-going basis; currently 30% [13 (incl. NMOs, new grads and Hiring Hall controllers) of 42] staff in OP are on temporary	(b) Establish job specific training for outage planners. (e.g. NMOs and OP Controllers)		**ONGOING** Required training details being gathered for a training session in September to the NMOs. Plan will be to implement this as a yearly session for the NMOs and Controllers.

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	assignment. This creates challenges in training and retention of institutional knowledge.			
Transmission Outage Management #2015–25 January 7, 2016	**4.0 TSOG Effectiveness**			
	(a) NOD should increase its profile and input of system operating perspectives (e.g. critical BES equipment outages statistics) to drive multi-year outage planning.	(a) NOD will develop a future view of planned and potential outage opportunities for critical BES equipment. (e.g. (i) optimal time windows and exclusion time windows for difficult to achieve outages, (ii) continue work through Program Management to achieve SAP maintenance cycle alignment.)	M	**ONGOING** The long term planning aspect continues with the recent involvement with the NOD Long Term Planners attending Asset Management team meetings to create better engagement and awareness
	(b) An increased profile of TSOG and its importance needs to ensure sufficient and timely engagement of all Lines of Business (including Planning/AM)	(b) Communicate at the senior management levels the importance of coordinated planning across the company beginning with the "Needs Assessment".	M	**COMPLETE** – Q1, 2016 The outage application efficiency metric is discussed at the Monthly Operations meeting with senior management and issues where outage planning is not coordinated can be dealt with at the senior level.
	(c) A more robust solution is required to better integrate the TOAST[3] functions with NOMS[4].	(c) Continue to develop the Microsoft Dynamics model for TSOG work flow and tracking to replace current MS Access platform.	M	**ONGOING** The TOAST tool continues development with the review of using CRM as the base. Currently a crude model is in place and we will continue to develop the tool. We are currently investigating the possibility of

[3] TSOG Outage Assessment Scheduling Tools (TOAST) where TSOG is Transmission System Outage Grouping

[4] NOMS Network Outage Management System - Software system to submit and process all outage requests within Hydro One

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				rolling the TOAST functionality into out new NOMS V3 platform which would bring better alignment of all of our tools into a single location.
Transmission Outage Management #2015–25 January 7, 2016	**5.0 Interface – Internal HONI Lines of Business**			
	(a) The quality of information submitted through the outage applications process (e.g. Outage Recalls and Contingency Plans) is generally poor, with some exceptions. There is no established Quality Assurance or Quality Control mechanism to systematically track the quality of outage application information and provide feedback to the applicants. Also, there are no formal guidelines on the quality or quantity of this information submitted by the applicant in NOMS.	(a) Establish guidelines for submitting Outage Recalls and Contingency Plans to address defined minimum requirements in outage application and communicate issues, quality and expectations to LoB stakeholder management. Monitor and drive quality improvement and communicate quality expectations/issues to LoB stakeholder management. Establish a mechanism to collect quality of outage application information (NOMS) (e.g. recall, impact, costs) monitor and drive quality improvement.		**COMPLETE** – Q2, 2016 The Long Recall report is now in effect and the first report was sent to all LoBs in June. The report also has a tracking mechanism for tracking outages that are recalled. The NMI for CP requirements has also been updated and a contingency plan is now required for any outages that are greater than 6 hours.
	(b) The expected internal lead time for outage applications is set at 33 days in advance of the required outage, as per NMI-2501 . Based on present outage planning performance rates, only	(b) NOD to notify LoB management of historical performance and expected improvement needed for January 2016 lock-down and in the short time remaining until implementation of SE-109.		**COMPLETE** – Q3, 2016 A distribution list including senior management was created and sent to advise of the upcoming SE-109 changes. Town Hall events have taken place across the Province to capture all LoBs and ensure the details of the changes are

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	56% of submitted outage applications meet this requirement. Continued submission of outage applications at the present performance rate will violate the required similar outage application lead time specified within the IESO's pending SE-109 process to be implemented in 2016. LoB management are not fully aware of changes and impact of the pending lock-down of outage applications planned for March 2016, driven by the IESO's SE-109 process.			received. Notifications have also been included in Customer Reports, NOMS blasts and the News articles. Outage Planning and Efficiency reports have been modified to include more details including the Stations and their performance which were broadcast to the other LoBs to share with their specific work areas for assessment and improvements.
	(c) There is a backlog of defective equipment tagged in the Network Management System (NMS) that could adversely affect the outage management process by rendering the equipment unavailable for switching or isolation for planned work, NOD Operating Effectiveness (OE) cross references between NMS tags (defective equipment tagged in NMS)	(c) NOD's weekly defect report circulation should include Maintenance Schedulers and Planning Scheduling Technicians. Also, a statement should be included in the email send to highlight the impact that the outstanding defects can have on outage plans and on system operations along with expected follow up action. Also, create a cumulative list of aging defects (i.e. not been repaired for longer than 3, 6, 9, 12 months) and aging		**ONGOING** The report has been transferred into Operating Planning on schedule. The latest NMS upgrade has added a defect select feature in the NMS tags that will be used to generate the report and creates a significant time saving in generating the manual report. The next stage is to build on the report and capture historical data. Also, the link between SAP and NOMS is

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	and SAP Defect Reports to ensure equipment is tagged in both systems and report the results to Station Services Grid Operations Field Managers and Grid Operations Managers on a weekly basis to ensure DRs are also recorded in SAP. The report only contains discrepancies between the two systems and does not track the cumulative count of outstanding defect. There is currently approximately 10,000 tagged items in the NMS with varying impact to execute planned outages.	defects should be escalated.		expected to be a requirement in the NOM V3 upgrade and would allow for these details to be captured immediately and the report would become obsolete.
	(d) There is no monitoring in place to ensure that a Load Transfer form is filled out and sent when needed, as per the documented process. Some On-Shift Controllers were not familiar with the process.	(d) Establish monitoring to ensure that Load Transfer forms are sent to the Settlement group when required and in particularly when prescribed within the NOMS slips.	M	**COMPLETE** – Q2, 2016 The Settlements group has shown significant improvement in the process and they are now regularly capturing the Load Transfer reports. Training was completed and Operating Planning has implemented the process. Nightly, Control Room Staff to monitor and close out any overdue transfers.
Audit of Provincial Lines – Job Safety	**1.0 Job Safety Planning Directive**			
	Amend *TD1000* to ensure that it includes a clear requirement for	*TD1000* will be amended to include wording as stated in *Hydro One Safety*	M	**ONGOING** New JSP process has been clearly defined

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Planning #2015-27 January 14, 2016	all jobs to be planned using the job steps, hazards and barriers methodology, and update the supporting Crew Communication Tailboard Folder, Crew Communication Task Form, and Work Centre Job Plans, where required.	*Rules* – Rule 229. Job Sheets listing "Job Steps, Hazards, and Barriers" will be created and inserted into the related Tailboard folders.		with written direction accompanied by a video presentation sent to field for Q2 implementation. Revisions to TD 1000 will be made in Q3 based on field visit / WSO findings. **COMPLETE** - Q3, 2016
Audit of Provincial Lines – Job Safety Planning #2015-27 January 14, 2016	**2.0 Job Safety Planning (JSP) Training**			
	Investigate opportunities to improve the quality of JSP training, giving consideration to: • Increased focus on job steps, hazards and barriers. • Lines related scenarios. Alignment of Networks' and Provincial Lines' Job Planning procedures, training materials, and annual Health and Safety Roll-out	The creation of new Job Sheets and amendments to *TD1000* will be communicated during training delivery.		**ONGOING** New job sheets have been created. New JSP material will be included in future training. TD 1000 scheduled to be modified Q3**.**
Audit of Provincial Lines – Job Safety Planning #2015-27 January 14, 2016	**3.1.1 Job Safety Planning Execution - Effectiveness of Tailboard Conferences - Comprehensiveness:**			
	Reinforce expectations for completion of the Crew Communication Tailboard Folder/Form and effective Tailboard discussions, to ensure alignment with *Hydro One Safety Rules* – Rule 229.	Expectations for crew communications to be identified in Provincial Lines 2016 Health and Safety Initiatives. These Initiatives will be discussed at the 2016 Health and Safety Roll-out.		**COMPLETE** – Q1, 2016

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	Ensure expectations are clearly understood and implemented by all employees through Job Plan training, the annual Health and Safety Roll-out; and monitor effectiveness of implementation through the Workplace Safety Observations process.	Expectations to be clearly identified during Temporary Union Trades Supervisor (TUTS) training in 2016.		**COMPLETE** – Q1, 2016
Audit of Provincial Lines – Job Safety Planning #2015-27 January 14, 2016	**3.1.2 Job Safety Planning Execution - Effectiveness of Tailboard Conferences - Crew Participation:**			
	Address the need for two-way communication when amending *TD1000 (*refer to above-noted Recommendation 1.0) and reinforce expectations during training and through Workplace Safety Observations.	(a) These expectations will be clearly identified during the 2016 Health and Safety Roll-out. (b) Further supervisor development opportunities will be addressed through TUTs training and Supervisor JSP accountability sessions (as part of 2016 initiative). Supervisor JSP sessions to be developed and scheduled by February 2016. Rolled out to all staff by end of Q4 2016.	M	**COMPLETE** – Q1, 2016 **ONGOING** New JSP folder and sheets being rolled out to field in Q2. New JSP material has been included in 2016 TUTS sessions. Supervisor JSP sessions currently being scheduled for Q3 / Q4.
Audit of Provincial Lines – Job Safety Planning #2015-27 January 14, 2016	**3.1.4 Job Safety Planning Execution - Effectiveness of Tailboard Conferences - Working to the Job Plan:**			
	Reinforce expectations for adherence to the Job Plan with all Provincial Lines' staff and monitor/enforce compliance through Workplace Safety Observations.	(a) A summary of this audit will be rolled out at the 2016 Managers' conference. (b) Expectations to be included in JSP Supervisor development sessions conducted throughout 2016.	M	**COMPLETE** – Q1, 2016 **ONGOING** New JSP folder and sheets being rolled out to field in Q2. New JSP material has been included in 2016 TUTS sessions. Supervisor JSP sessions currently being

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
				scheduled for Q3 / Q4.
Audit of Provincial Lines – Job Safety Planning #2015-27 January 14, 2016	**3.2 Job Safety Planning Execution - Quality of Filed JSP/Tailboard Documents**			
	Revise *TD1000 Section 6.0* - Evaluation *of Compliance* to ensure Manager/Supervisor reviews of completed for job planning documents and establish expectations for the percentage of Job Plans to be reviewed; and methods of recording and compiling findings.	(a) *TD1000* will be amended to include requirements for Manager/Supervisor reviews. (b) The method of recording and compiling findings will be incorporated into Zone SharePoint sites.	M	**ONGOING** Supervisor monitoring requirements to be established based on needs analysis conducted as part of the Supervisor JSP field training sessions **ONGOING** TD 1000 amendments will be completed.
Audit of Provincial Lines – Job Safety Planning #2015-27 January 14, 2016	**4.0 Evaluation Of Compliance**			
	Clarify expectations of Supervisory staff related to the need to include meaningful commentary on WSO Forms, particularly the inclusion of comments related to the quality of Job Safety Planning and Tailboards.	WSO forms will be modified and communicated through JSP Supervisor development sessions conducted throughout 2016.	M	**ONGOING** Will be completed once JSP pilots complete and new process documented in TD 1000 and fully adopted.
Audit of Station Services – Job Safety Planning #2015-28 January 14, 2016	**2.1 Job Safety Planning Execution - Effectiveness of Job Safety Plan/Tailboard Conferences - Comprehensiveness**			
	Reinforce, on a regular basis, Station Services' expectations of an effective and comprehensive Job Plan and Tailboard.	During the year at least three monthly safety meetings will deal with job planning.	M	**COMPLETE** – Q1,2016
Audit of Station Services – Job Safety Planning	**2.3 Job Safety Planning Execution - Effectiveness of Job Safety Plan/Tailboard Conferences – Use of Job Planning Tools**			
	Reinforce, on a regular basis, expectations for the	This will be included in the Workplace Safety Observations planning for	M	**COMPLETE** – Q1, 2016

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#2015-28 January 14, 2016	identification of appropriate job steps in the job planning process. Monitor the conformance to this expectation through Workplace Safety Observations and review of completed Job Plans.	Stations and will be become part of the review of completed Job Plans by the Managers.		
Audit of Station Services – Job Safety Planning #2015-28 January 14, 2016	**3.1 Oversight of Job Safety Planning/Tailboards - Effectiveness of Oversight:**			
	Clarify, for those performing Workplace Safety Observations, what the Job Planning/Tailboard expectations are.	The revised WSO Form and associated training will clarify the requirement that at least 50% of the required WSOs will include observations of Tailboards.		**COMPLETE** – Q1, 2016
Disaster Recovery Review #2015-30 February 18, 2016	**1. Business Impact Analysis (BIA)**			
	The BIA process should be modified as follows: - Ensure that business units understand and identify accurate risk ratings (Recovery Time Objectives and Recovery Point Objectives) for each of the listed critical applications. - Perform an overall (entity wide) analysis of the BIA results to prioritize the critical applications. Prioritization should include impact to shareholder value, safety, customer, reliability, and productivity. - PSIT and Enterprise IT personnel should be included in	An initiative to reword the question in the BIA for critical applications is in process. EIT will be consulted. Quarterly meetings with PSIT & EIT will be set up.		**ON SCHEDULE** – Q4, 2016 In the 2016 BIA form an additional list of critical applications provided by EIT was added for LOBs to fill out. BIAs were due March 31st 2016. 2016 BIAs are completed with the new question on RTO/RPO. The information has been passed to EIT. We are continuing to meeting with EIT quarterly. PSIT is joining the meeting in July.

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	the overall evaluation of the critical application listings.			
Disaster Recovery Review #2015-30 February 18, 2016	**2. OGCC Disaster Recovery Plan(DRP)**			
	(a) [redacted] (b) [redacted]	[redacted]	H	(a) **COMPLETE** – Q2, 2016 [redacted] (b) **ON SCHEDULE** – Q1, 2017 [redacted]
Disaster Recovery Review #2015-30 February 18, 2016	**3. BUCC Server Room Access Controls**			
	[redacted]	[redacted]	M	[redacted]
Disaster Recovery	**5. BUCC Server Room Maintenance**			

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Review #2015-30 February 18, 2016	[redacted]	[redacted]	M	**COMPLETE** – Q2, 2016 [redacted]
Disaster Recovery Review #2015-30 February 18, 2016	**6. 2013 BUCC Flood**			
	All cable conduits should be re-sealed. This includes the immediate re-sealing of the cable conduits after maintenance work are performed. Periodic preventive maintenance should be performed regularly on cable conduit penetrations to minimize the risk of flooding and vermin.	In January 2016, PSIT informed Internal Audit that the cable conduits holes have been re-sealed.	M	**COMPLETE** – Q4, 2015
Disaster Recovery Review #2015-30 February 18, 2016	**7. BUCC Site Information**			
	Ensure information assets are properly classified and protected from unauthorized disclosure. At a minimum, this information should be made available only to Hydro One personnel on a need to know basis.	[redacted]	M	**COMPLETE** – Q4, 2015

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Audit of Construction Projects Management Processes # 2015-32 March 8, 2016	**1.1 Strategy/Organization - Project Management Methodology /Process**			
	We recommend that management identify a project management methodology and establish a consistent process that Project Management will follow, so that performance can be evaluated based on identified controls.	Project Delivery will ensure a consistent framework is documented and adhered to for all projects. This framework will follow project management best practices for Scope & Quality Management; Schedule and Cost Management; Risk & Issue Management; and Stakeholder Management. Initial framework to be refined in Q1/Q2 with full rollout to all staff and all projects by Q3, 2016	M	**Behind Schedule.** Revised completion date: Q1, 2017. By the end of 2016, a transition plan will be finalized and rolled-out for full implementation of the Project Execution Plan to assess and decide on how to proceed with the recommendations provided. 18 Pilot projects will run through the new Project Management Methodology beginning in Q3, 2016 for refinement and validation. - Final review and evaluation of new methodology will occur by the end of 2016 which will be implemented on all capital projects beginning in 2017.
Audit of Construction Projects Management Processes # 2015-32 March 8, 2016	**1.2 Project Execution Plan**			
	We recommend management to mandate preparation and use of the Project Execution Plan.	Project Management will develop a threshold matrix where PEPs are a mandatory requirement; i.e., Board level, $ amount, Complexity. As a part of the Project Management methodology implementation, Project management will ensure PEPs are a mandatory requirement for all projects greater than $10M or items that have significant project complexity.	M	**On Schedule.** Completion date: Q3, 2016. By the end of 2016, a transition plan will be finalized and rolled-out for full implementation of the Project Execution Plan to assess and decide on how to proceed with the recommendations provided. 18 Pilot projects will run through the new Project Management Methodology beginning in Q3, 2016 for refinement and validation. - Final review and evaluation of new methodology will occur by the end of

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				2016 which will be implemented on all capital projects beginning in 2017 - A Standardized Project Execution template has also been developed for input from PM's and Burns and McDonnell. This is currently being stakeholdered with various senior PM's to solicit feedback and input Established Future Plans - Implement and roll out process by the end of Q3 , 2016 - Sign off from Directors and Burns and McDonnell for alignment with overall Project Management Methodology - Roll Out Execution plan mandate to all PM's for all projects greater than $10M in Q3, 2016.
Audit of Construction Projects Management Processes # 2015-32 March 8, 2016	**1.3 Alignment Between Various LoBs**			
	Recommendations made for the observations 1, 5, 6, and 7 in the Asset Deployment Audit Review will apply to this observation. However, in summary we recommend that management should re-evaluate the existing organizational relationship to provide more effective accountability between the team members involved in the projects	As a follow up to the Asset Deployment Audit, Work Program Management is leading the initiative to develop cross LoB business processes and KPIs to ensure the successful delivery of the capital work program. The ongoing management reviews will look at process, organization and toolset improvements to drive continuous improvement. Actions will be tracked under the Asset Deployment Audit.		**COMPLETE** – Q3, 2015 **COMPLETE** – Q4, 2015 Work Program Management has developed Key Performance Indicators for each of the LoB's involved in the Asset Deployment Process (From Initialization i.e. Asset Management to Project Closure and Lessons Learned i.e. Project Delivery) These are updated on a monthly basis and rolled up to the Director and VP Level to

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				gauge performance and productivity trends. In addition, a weekly project dashboard has also been developed that measures project status at each stage gate from Investment planning, to Engineering and Project Services. This dashboard is reviewed at the weekly Directors forum to address and issues and also to proactively address and projects that may be in jeopardy of missing target dates. Finally, a weekly Project Tracking report is sent out and distributed with Minutes of Meeitng/Action Items to all applicable LoB's (i.e Engineering, Project Services; Construction Estimating, Work Acceptance, Project Planning, etc.) This is used to address any outstanding project status and provides an update on deliverables during the lifecycle of project planning phase. As well, an E&CS month end review is in place which provides all planning directors with an update on project status in execution.
Audit of Construction Projects Management Processes # 2015-32 March 8, 2016	**2. Quality Assurance**			
	Management should put a standard Quality Assurance process in place and project teams are required to adhere to.	We will establish a high level Quality Assurance framework for project management		Behind Schedule. Revised completion date Q2, 2017. - Burns and MacDonnell initiative aims to address the lack of a Quality Assurance framework by putting PEPs in place that establishes a framework that addresses Estimating, Risk Management, Cost/Budget & Funding, Scheduling,

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				Change Management, Document control and Reporting. All these tasks working in harmony will allow Quality Assurance by establishing consistence and constant monitoring that PD practices are followed. This QA plan will be included as part of the final Project Execution Plan. Established Future Plans - Once we has run through the 18 pilot projects at the end of 2016, we will be in a position set the expectation on project performance and monitor project performance to those expectations. Target date full implementation is Q2 - 2017.
Audit of Construction Projects Management Processes # 2015-32 March 8, 2016	**3. Scope - Asset Registry**			
	Management should ensure that the Asset Registry in SAP is updated as soon as the project reaches its closure status	Project Management ensure major system components and directly associated auxiliary supplies are registered. If they were not, the IESO would not allow us to place the asset in-service. In addition, as a part of the project closure process, it is now a requirement to ensure all SAP Asset Registry information has been updated before the project is closed. Management will take the action to review to ensure these activities are being completed and documented appropriately in project closure reports.		Behind Schedule. Revised completion date: Q4, 2016. A project close out process is in place that also confirms if updates to the Asset Registry have been finalized prior to sign off for completion. This is being refined to also define the requirements for projects <$5M that will include an Asset Registry checklist for these smaller budgeted projects to ensure Asset registry updates are completed. Target for full implementation for his refined Asset Registry Tracking Process is Q4, 2016
Audit of	**4. Risk Management – Risk Methodology**			

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
Construction Projects Management Processes # 2015-32 March 8, 2016	Management should implement a standard and detailed Risk Methodology recommended by the Enterprise Risk Management Group to be utilized in all projects.	Project Management will continue to participate in the corporate initiative to improve risk management practices for Projects. Work Program Management has completed a pilot for an overall project risk management framework and tool set for identifying project risks during the project definition phase and tracking these items through the delivery phase. This framework will be rolled out to all projects >$20M in 2016.		Behind Schedule. Revised completion date: Q1, 2017. An established Risk Management Process and Framework has been established and defined. This Process aligns with and is in sync with Hydro One's Enterprise risk Management Methodology. Established Future Plans Implementation of agreed upon methodology to be rolled out and in Q3 and Q4, 2016 for all projects>$20M. Once this subset of projects have been piloted, we will determine and refine the remaining project risk process to be used on all projects based on categorized budget thresholds.
Audit of Construction Projects Management Processes # 2015-32 March 8, 2016	**5. Scheduling - Description of Variances**			
	We recommend that management should require: 5.1 Full and detailed explanation for schedule variances. 5.2 Immediate preparation of VCN when changes are evident.	Project Delivery will ensure : (a) Expectations are clearly articulated when reporting variances. (b) Training to be conducted as required. (c) Input from Decision Support and Regulatory Affairs is garnered during development for those projects where PD is reporting the variance.		5.1 **COMPLETE** – Q1, 2016. 5.2 Behind schedule. Revised completion date is Q3, 2016. Timely notification of variance likelihood and associated review/reporting in progress. A mapping process is currently under development in concert with WPM, AM, Decision Support and Finance with a July 19, 2016 meeting scheduled to finalize expectations and deliverables from various departments involved in variance controls.
Audit of	6. **Costs - Project Cost Estimates**			

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
Construction Projects Management Processes # 2015-32 March 8, 2016	We recommend management put in place: 6.1 A comprehensive process which will enable more realistic method of project cost estimating 6.2. A temporary process as a workaround until the comprehensive project cost estimating method is implemented	1.We will review and revise the estimating process identifying best practices and benchmarks. 2. We will, where practical/possible, obtain an RFP response for outsourced projects prior to seeking approval for the full release. This will be much easier once we have pre-qualified vendors.	M	**COMPLETE** – Q2, 2016. An Estimating Process Refresh Initiative jointly sponsored by Work Program Management and Engineering Services which encompassed the following objectives has been completed: Identifies and clearly defines the roles and accountabilities for stakeholders supporting the early engineering and estimate development process lifecycle and other pre-approval activities. Identify and incorporate improvements to the current end-end process in order to support a release quality estimate and ensure alignment with the Shovel Ready initiative.
Audit of Construction Projects Management Processes # 2015-32 March 8, 2016	**Reports**			
	6.3 We recommend that management put a process in place to enhance the quality of reporting. 6.4 Poor upfront planning results in not identifying required resources in a timely manner	Work Program Management will conduct a detailed review as a part of the project management methodology to ensure that all processes and tools are optimized for project and program reporting. After the review is complete, a work plan will be developed and implemented to improve the reporting framework.	M	Behind schedule. Revised completion date Q2, 2017. We have established and Earned Value methodology and 9 projects will be assessed against this methodology. Once these 9 projects have been proven out against the new methodology, we will implement the methodology on all other applicable projects. Behind schedule. Revised completion date Q4, 2017. The project controls initiative is aiming to create resourcing reports for direct work related to capital projects. This will

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
				provide better visibility of Construction resources - specifically for direct work at the Construction foreman level which allow for better management and planning of construction crews. This initiative is expected to be in place in Q4, 2017
Audit of Construction Projects Management Processes # 2015-32 March 8, 2016	**Contingency**			
	6.5 We recommend that a requirement be put in place to: 1. Require use of contingency funds for specifically those occasions which have been forecasted and documented in the project approval process. 2. Monitor remaining contingency balance to ensure it does not exceed the required 25% (threshold) of remaining Gross Spending a month over month. 3. Report remaining monthly contingencies accurately.	Project management utilizes the VCN process to review contingency use and approve the release of contingency. Project management will continue to refine/improve the VCN process to ensure quality submissions. A quality review will be completed quarterly to ensure consistent and quality submissions. Project Management will develop a set of reports to review overall contingency usage, remaining balances and ensure contingency is released when risks are mitigated and report on overall contingency within the portfolio.		On Schedule for completion in Q4, 2016
Audit of Construction Projects Management Processes # 2015-32	**Forecasting process and Cost Monitoring**			
	6.6 We recommend that management introduce a comprehensive standard forecasting methodology to be utilized by the project management team for more	Management will develop and rollout a more robust and consistent forecasting methodology, process and toolset.		Behind schedule for Q3, 2016. Revised completion date Q1, 2017. A forecasting guideline has been established for a more consistent methodology to forecasting

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
March 8, 2016	accurate forecasting for both cost and schedule.			This has been sent out to all PD Managers Established Future Plans - Roll out the forecasting guidelines to all PM's to adhere to - Burns and McDonnell assessing our current scheduling processes and will be recommending improvements which will include earned value reporting. This will allow for a more accurate forecast which will based on accurate tracking of monthly accomplishments. We will also be tying in the schedule to drive financial forecasts beginning in 2017.
Audit of Construction Projects Management Processes # 2015-32 March 8, 2016	**Earned Value**			
	6.7 Project Office should introduce a process which provides monitoring of project performances when Earned Value is not applicable to certain projects.	Project management will ensure that EV reporting is utilized for all projects >$10M by the end of 2016. For smaller projects, month end status reporting on project progress, issue management, financial forecasting and overall project health for cost and schedule will remain as the tracking framework.	M	On schedule for completion in Q4, 2016 A Pilot Earned Value report have been established and being used for The Clarington Project Established Future Plans - Restructuring of the WBS and develop estimating and scheduling templates to facilitate earned value management for - In the absence of earned value reports (i.e.. where earned value reporting is not deemed practical or an efficient use of resources/smaller budgeted projects) Monthly review meetings are used as a forum to analyze and review project performance in terms of cost, schedule, and project issues.
Transmission	**1.1 PMO Investment Documents**			

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
Lines Preventive Maintenance Optimization #2015-33 April 7, 2016	Ensure completeness and consistency of details within various PMO investment planning documents across all asset types such as asset strategies, planning documents, investment summary reports, scopes of work and work standard documents.	The format of planning documents will be reviewed for content consistency. Templates will be developed and posted to the Tx AM Lines SharePoint site for use by the Planners.	M	**ONGOING** Documents under review
Transmission Lines Preventive Maintenance Optimization #2015-33 April 7, 2016	**1.2 Maintenance Planning Process**			
	Update and approve the Maintenance Planning process to ensure consistency across all asset types and ensure that appropriate maintenance planning process training and/or knowledge transfer is in place for new planners.	The Transmission AM draft maintenance planning process will be stakeholdered and finalized.	M	**ONGOING** Draft documents under review
Transmission Lines Preventive Maintenance Optimization #2015-33 April 7, 2016	**2.1 Maintenance Strategies**			
	Document risk-based, asset-specific maintenance strategies that detail what maintenance tasks need to be performed and how often, criteria to identify opportunities and associated risk of delaying maintenance. This strategy can then be applied for consistent identification of risk-based investment alternatives (vulnerable, intermediate,	Asset strategy documents have been developed and will be reviewed to ensure inclusion of asset- specific maintenance planning strategies.	H	**ONGOING** Asset strategy documents under review

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	optimal or accelerated).			
Transmission Lines Preventive Maintenance Optimization #2015-33 April 7, 2016	**2.2 Annual Review of Maintenance Strategies**			
	Perform an annual review of the asset specific maintenance strategies for further optimization opportunities: • Identify, collect and analyze key asset performance and condition information to validate that maintenance plans are optimal. • Delay or reduce maintenance of non-critical assets to determine optimal maintenance tasks and frequency. • Identify and implement maintenance bundling opportunities with other work programs.	(a) Maintenance strategy documents will be reviewed annually for further optimization opportunities as per the Asset Strategy document referred to in 2.1 above. (b) Existing collaboration with the TSOG process will be enhanced to investigate and consider outage bundling opportunities for planned PM work.		**ONGOING** Asset strategies under review
Transmission Lines Preventive Maintenance Optimization #2015-33 April 7, 2016	**3.1 Risk-based prioritization**			
	Clearly document supporting data and/or planner judgments that are used for risk-based prioritization of various funding levels along with asset-specific planned accomplishments for each funding level.	AIP risk assessments will be reviewed with the intent to capture supporting data and any qualitative information used for risk assessment.		**ONGOING** This year, AIP training focused on risk-assessment and AIP checklist were created whereby risk assessment was mandatory. All info is in AIP.
Transmission Lines Preventive Maintenance Optimization	**3.2 Unit Costs**			
	3.2 Ensure that the unit costs being used to determine funding levels are as per current	3.2 (a) The planners will document in AIP any changes to unit prices that they have agreed with the		**ONGOING** Each planner is documenting and storing in SharePoint/AIP and inform Investment

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
#2015-33 April 7, 2016	Unit Price Catalogue agreed with the service providers.	service providers and inform Investment Management of these changes. 3.2 (b) Investment Management will update the UPC with newly revised unit prices when advised by either the planners or service providers.		Planning.
Transmission Lines Preventive Maintenance Optimization #2015-33 April 7, 2016	**4.1 Regulatory Maintenance**			
	4.1 Ensure that NERC impactive circuits and their vegetation maintenance accomplishments are tracked and reported from SAP, which is the official source for maintenance costs and accomplishments tracking.	4.1 (a) A formal report from FMS will be developed for regulatory reporting purposes replacing the manual spreadsheet based report. 4.1(b) FMS will be used instead of SAP for accomplishment reporting as FMS is the system being used by the Service Providers for accomplishment tracking.	H	**ONGOING** Work is continuing on developing an automated report. **COMPLETE** – Q1, 2016 SAP and FMS accomplishments are aligned.
Transmission Lines Preventive Maintenance Optimization #2015-33 April 7, 2016	**4.2 Monitoring of SAP Work Orders**			
	Develop a process and clarify accountabilities to ensure that appropriate Work Orders are created in SAP to monitor the annual work accomplishments.	Tx Lines AM will document a process and accountabilities for work orders released in SAP, and monitor with monthly reporting.	H	**ONGOING** Process and accountabilities are being documented for all TAM.
Transmission Lines Preventive Maintenance Optimization #2015-33 April 7, 2016	**5.1 Monthly Variance Review Meetings**			
	Ensure that discussions and decisions resulting from monthly variance monitoring meetings are documented and action items are monitored for	Meeting minutes from quarterly meeting with the service provider will be documented.	M	**ONGOING** Meeting minutes are being documented and stored on SharePoint site.

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	completion. This includes changes resulting from funding reductions and ability to execute the work (maintenance unit swapping).			
Transmission Lines Preventive Maintenance Optimization #2015-33 April 7, 2016	**5.2 Overhead Line Accomplishment Budget**			
	Ensure that Overhead Line accomplishment budget is identified in the PP-177 Report (currently missing).	Tx Lines AM will ensure that service providers report on the Statistical Key Factor (SKF) in each quarterly meeting.		**ONGOING** TxLines engaged service provider to ensure SKF is provided.
Transmission Lines Preventive Maintenance Optimization #2015-33 April 7, 2016	**5.3 Planning Issue Log**			
	Develop and maintain a planning issue log to capture and resolve various process and data issues raised during planning and execution discussions on a timely basis.	Tx Lines AM to implement a planning issue log to identify issues and track actions to resolution.		**ONGOING** Issue logs are being implemented and centralized.
Transmission Lines Preventive Maintenance Optimization #2015-33 April 7, 2016	**6.1 Use of Asset Condition Reports**			
	Ensure consistent reporting, analysis and use of asset condition reports for asset maintenance needs and adjustment.	Review and incorporate the requirement for consistent reporting, analysis and use of asset condition reports into the asset strategy document and into the maintenance planning process (see 1.2).		**ONGOING** Discussions taking place with planners for requirement. Strategies are being reviewed and will incorporated where applicable.
Inergi Services IT Contract Management Review #2015-35	**1. Service Level (SL) monitoring.**			
	Implement a periodic and independent validation of SL reports and supporting performance data submitted by	Our team is in the process of rolling out the VMWare IT Business Management (ITBM) tool. This tool will allow us to independently verify data provided by		**ON SCHEDULE** – Q4, 2016 Design in Progress - Validation check list template and verification rules being developed.

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
June 9, 2016	Inergi, including reasonability checks on the accuracy and completeness of data utilized in the service level metric calculations.	Inergi. The VMware ITBM offers transparency and control over IT costs, services and quality and automates manual processes.		
Inergi Services IT Contract Management Review #2015-35 June 9, 2016	**2. Quality controls in the acceptance of contract deliverables**			
	(a) [redacted] (b) Ensure Hydro One is engaged during the planning phase of the audit to confirm that the vendor's Internal Audit is using Hydro One's policies as a baseline for testing, applicable testing methods are performed and remedial actions are appropriate and completed in a timely manner. [redacted]	(a) Ownership discussion with Security Operation group and Outsourcing Services group will be scheduled, and an owner will be specified. [redacted]		(a) **ON SCHEDULE** – Q3, 2016 [redacted] (b) **ON SCHEDULE** – Q4, 2016

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	[redacted] This includes defining the quality criteria and ensuring that issues noted are remediated in a timely manner.			
Inergi Services IT Contract Management Review #2015-35 June 9, 2016	**3. Timely delivery of contract deliverables**			
	(a) Ensure that critical deliverables are delivered within the revised timeframe. (b) Establish a deliverable verification and sign-off process for non-critical deliverables to limit discrepancies in deliverable status issues with Inergi. Develop and implement a plan to ensure continued timely delivery, review and approval of deliverables.	As part of the agreement in 2015 documented through a memorandum, Inergi has agreed to deliver the remaining Critical and Non-Critical deliverables as part of a focused effort. These deliverables will be provided through the execution of the project plan for the 5 delivery areas. These items are Information Technology Infrastructure Library (ITIL), Application Monitoring, Application Portfolio Management, Reporting, and Continuous Improvement.	M	**ON SCHEDULE** – Q4, 2016 In Progress - Project Plan developed and ongoing review of progress (monthly).
Audit of Safety Investigation – Follow Up Audit #2015-36 June 23, 2016	**1.0 Safety Incident Investigation Process**			
	Overarching Recommendation: Complete a broader, objective review of the Safety Incident Investigation process to determine the underlying contributing factors leading to inconsistent determination of Causal Factors, Root Causes and Corrective Actions, with the objective to improve the overall adequacy, consistency, and effectiveness of this process,	Management agrees with this recommendation and will complete a comprehensive, objective review of the Safety Incident Investigation Process, involving the following: (a) Conduct a Workshop with applicable LoBs / Investigation team stakeholders to review and understand Watershape Safety Analysis Inc. findings and conclusions. (b) Conduct a Root Cause Analysis on	H	**COMPLETE** – Q3, 2016 **ONGOING**

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	considering, but not limited to, the following: • Adequacy of current investigation methodology; • Training methodology and delivery; • Frequency and type of refresher training; • Investigation Team composition, competency, and independence; • Existing barriers to addressing *Human Performance* Root Cause issues; • Implementing additional quality assurance steps in the process; and • Consider utilizing expertise, independent of the current process, in order to facilitate an objective review and allow new perspectives to be evaluated.	the overall Safety Incident Investigation process, considering the observations and recommendations provided in this report. We will also complete a review of the Tripartite Agreement related to system investigations, as part of this analysis. (c) Develop and implement a Corrective Action Plan(s) to address the findings of the Workshop and Root Cause Analysis.		TapRooT investigation planning underway with 1st meeting planned. Target does not appear to be at risk. **ONGOING** TapRooT investigation planning underway with 1st meeting planned. Target does not appear to be at risk.
Audit of Utility Work Protection Code Governance #2015-37 June 1, 2016	**3.0 Quality Assurance and Monitoring**			
	Enhance the monitoring process of the UWPC application within Networks to include, but not limited to: • Reinstating a condensed version of the quarterly UWPC quality assurance audit to ensure effective application of	We will conduct a review within, but not limited to, the scope of the recommendation and update all processes accordingly, to enhance the monitoring process of the UWPC application with Networks.	M	**ONGOING** No action initiated to date.

Audit	Recommendation	Action Plan	Risk	Status of Action Plan
	the UWPC. • Requiring LoBs to communicate UWPC self-assessment results to the UWPC Coordinator for trending analysis			

SUMMARY OF THE 2015 INTERNAL AUDIT PROGRAM

Strategic Issue / Risk	Discussion	Audit Focus Area
Assets (Tx and Dx)	Sustaining the overall reliability of the grid and quality of service to Hydro One's customers is a key objective. Ensuring that Hydro One optimizes the information on equipment, to manage the electricity assets and protect the critical ones, is a key ingredient for success.	**Corporate Technical Standards:** This audit will review the state of Hydro One Networks' technical standards and supporting processes for standard development. Sufficient, effective technical standards are needed to drive efficiencies and support the capital work program. This focus area has not been previously audited. **Facilities Outsourcing (Contract Management):** Provide assurance that effective processes and controls are in place over the service provider for managing Hydro One's facilities. **Preventive Maintenance Processes (2003):** This is a follow-up audit from 2009 where Internal Audit concluded that controls over the scheduling process needed improvement because there were several minor control weaknesses. • Control over the completeness and accuracy of the maintenance schedule. • Control over maintenance plan cancellations. • Improved SAP input control for asset condition in shop papers. • Analysis and reporting on the maintenance backlog. • More comprehensive process documentation. • Regular review and approval of security authorization profiles. **Protection & Control, Teleprotections (2004):** This audit will review Protection, Control and Teleprotection governance, accountabilities, processes and controls. The P&C Regulatory Compliance audit in 2009 found weak controls in place. This audit would include a follow-up on audit recommendations & actions from 2009, their implementation and effectiveness. The scope to include application of standards, standard designs, training.

Note: The year after the name of an audit indicates the last time an internal audit was done of this area/process. No date indicates a new audit.

Strategic Issue / Risk	Discussion	Audit Focus Area
Customers	Meeting customer expectations is integral to delivering on our corporate mandate. Customer satisfaction plays a vital role in achieving our objectives for corporate reputation, shareholder confidence and regulatory approvals.	**Tx Planned Outage Management (2008):** This audit will include a review of processes and controls for effective outage management including interfaces with LoB Crews and the IESO. Approaches and processes associated with outage planning and outage management have changed in recent years. This audit will provide an assessment of the effectiveness of the shift of approach to bundled outages (e.g. TSOG) which promises reduced impact to customers, and reduced number of outages, reduced switching burden on equipment.
Financial Controls	Financial reporting has become of greater concern as a result of corporate and financial institutions' frauds and irregularities, and more rigorous regulations for governance. Boards are looking for assurance that record-keeping is accurate and information provided is valid.	**External Auditor Assistance (2014):** Assist the external auditors, as in prior years, for the year-end review of Subsequent Payments. **Treasury Operations (2011):** Review effectiveness of processes and controls at Treasury over authorization for payments and investments, documentation and retention of supporting evidence, accuracy and completeness of accounting entries, management review and monitoring procedures, timeliness and accuracy of bank reconciliations, and system security. **Warranty Claim Procedures:** A standardized process for handling of warranty claims is under development by the Supply Chain group. IAD will review the effectiveness of the proposed warranty claim handling process, and determine that sufficient controls are in place to manage warranty claims for vendor defects.

Strategic Issue / Risk	Discussion	Audit Focus Area
Health, Safety and Environment	Protecting the Health and Safety of employees is a key objective at Hydro One. The key controls in this area must be functioning effectively in order to meet this objective.	**Job Safety Planning:** The key to ensuring a safe and healthy workplace is to anticipate the hazards associated with the work assigned and to eliminate them where possible or implement controls to minimize the risk. This audit will assess the Job Planning effectiveness in the higher risk LOBs, i.e., Construction (2007), Forestry (2011), Lines (2011), and Stations (2011), by observing them in real time. **Safety Incident Management Follow-up (2013):** This audit is being conducted at the request of the CEO to assess the effectiveness of the corrective actions taken to address recommendations from an audit of this process conducted in 2013. **Utility Work Protection Code - Project & PC1 (OGCC/Field) (2010):** The UWPC is an administrative control employed to ensure that workers are protected from unwanted energy flow while working on or in the vicinity of electrical equipment and lines. It requires strict adherence to the process and precise communication between the Ontario Grid Control Centre and the LOBs. This audit will examine the effectiveness of the process from the time of application to when the protection is surrendered. **Work Process Inspections/Work Safety Observations – Construction (2012):** This key control over the quality of Job Planning and the safe execution of work was audited in the other field based LOBs in 2014. This is the last in that series of audits to assess the effectiveness in Construction.
Operational Controls	Hydro One has numerous processes in place to sustain and upgrade the assets and quality of service. These processes require ongoing management attention, control and improvement in order to be effective and efficient, and to maintain superior customer relations.	**Clarington Project:** Review controls over this major capital project to provide management with assurance that processes and controls are effective. **Construction Project Processes (2010)**: Provide management with assurance that project management processes and controls are adequately designed, documented and implemented and are effective for delivering projects within scope, with acceptable quality, on time, within budget, and in compliance with Hydro One's policies. This will include a review to ensure processes and controls are consistent across projects. **Corporate Scorecard Final 2014 & Preliminary 2015:** In 2014, we provided assurance that the Corporate Scorecard processes for collection and reporting of data were adequately designed, documented, implemented and monitored. In 2015, we will review the 2014 year-end

Strategic Issue / Risk	Discussion	Audit Focus Area
Operational Controls (continued)		results and also the 2015 processes and interim results to confirm that they are operating effectively and results are fairly stated. **DBOT Tendering:** Hydro One has gone to market to source a service provider to Design, Build, Operate and Transfer back to Hydro One a new process to manage the Call Centre. Our audit will examine the fairness of the tendering process and the awarding of the contract/s. **IROV Process:** Review processes and controls for effectiveness and timeliness of Interim Review or Variances (IROVs) for projects that exceed budget. **New Outsourcing Agreement Management (2003):** Provide assurance that effective controls are in place for monitoring and managing the new contract at the Statement of Work (SOW) level, including how Hydro One management exercises control over key processes at the service provider for transactions/assets. **Programs and Projams (Programs bundled at the Station level):** Review processes and controls over work bundling, accomplishment monitoring and variance reporting to provide assurance that they are effective. **Project Estimating:** This audit will review the processes and controls for effective estimating processes for Capital Projects.
Regulatory	The quality of interactions with the regulators will be to maintain Hydro One's credibility and proficiency. Rate filings are key to obtaining the required revenue to fund capital and sustainment programs. These must be of high quality and credibility.	**CDM (Conservation and Demand Management):** We will review Conservation and Demand Management programs to ensure that processes and controls are effective for delivering on the Ontario Power Authority's (OPA's) programs.
Technology Controls	The management of information is a key enabler in efforts to provide effective services to customers and to improve operating efficiency. To achieve greater efficiency in operations there continues to be a need for technology solutions. In addition, as Hydro One becomes more centralized and reliant on technology, the risk of intrusion and the	**Cyber Security - NERC CIP Follow Up re V5 (2013):** The audit will provide assurance that the CIP V5 project is adequately managed to meet CIP requirements by the required deadlines. We will also verify that the plan adequately addresses prior audit recommendations. In addition, this audit will assess the effectiveness of compliance audits that audit compliance with the NERC CIP requirements. **Disaster Recovery for I.T.:** The purpose of the audit is to provide assurance that adequate controls exist over the recovery of critical

Strategic Issue / Risk	Discussion	Audit Focus Area
Technology Controls (continued)	need for improved cyber security intensifies.	operating systems. The scope of the audit includes OGCC, BUCC, Corporate and Inergi operating centres. The audit will evaluate the adequacy of controls around disaster recovery planning, training, testing and continuous improvement. The audit will also assess the status of lesson learned action plans resulting from the 2014 flood. **IT Governance:** The objective of governance is to create value for stakeholders. To evaluate IT Governance, this audit will assess the effectiveness of IT Strategic Alignment, Value Delivery, Risk Management, Resource Management and Performance Management using concepts in the COBIT 5 framework. **IT Project Processes (2001):** The purpose of this audit is to provide assurance that good project governance is established and Systems Development Lifecycle processes followed for key IT projects, such as the NMS Upgrade Project. **I.T. Security Framework:** The purpose of this audit is to assess the effectiveness of the management over Information Security. Specific areas of review would include controls over planning, execution, monitoring results, quality assurance and stakeholder engagement. It will also include a review of SEIM Management and Malware/Virus Response to assess how these initiatives are being managed.

Final Audit Plan - 2016/2017

REVIEW AREA	SCOPE OF WORK	2016	2017
Corporate Audits			
Auditor General Report Follow-up 2016 Plan	Perform a follow-up review of the 2015 Auditor General's Report to ensure resolution to the findings.	Q3	
Auditor General Report Follow-up 2017 Plan	Perform a follow-up review of the 2015 Auditor General's Report to ensure resolution to the remaining findings of the report.		X
Shared Services			
Transport Canada Follow-up review (Helicopter)	Perform a follow-up review of the 2015 Transport Canada Helicopter operations audit to assess status of findings from the report.		X
Outsourcing - Facilities (Brookfield)	Review effectiveness of the outsourced Facility Management process at ensuring that the facilities are properly maintained and that contracted services are provided in a timely manner.	Q4	
Warranty Claims Procedure	Review the effectiveness of the proposed warranty claim handling process, and determine that sufficient controls are in place to manage warranty claims for vendor defects.		X
Duplicate Payment Analysis	Perform a duplicate payment analysis using data analysis techniques. Perform analytical analysis of suppliers and material purchases for cost savings and potential cost recovery.	Q3	
Procurement	Review controls around the Procurement process, including an analytical review of payment transactions, the process around sourcing and awarding contracts (technical specifications, considerations to the life-cycle costs and vendor selection factors). Review the controls around compliance to the Supplier Code of Conduct.		X
Inventory Management	Review procedures related to inventory receipts, issues, storage and associated maintenance of inventory records. The review will address system and strategic spares. Follow up the 2015 review of the Central Maintenance Services stores, and complement by including the Barrie Warehouse and sample stations TBD.		X
Fleet Services - Project Review: Telematics	Review project controls for the implementation of Telematics in Hydro One fleet, including user requirements, decision documentation, testing, organizational change management and delivery against objectives. Assess the adequacy of the tools to support the Fleet Planning process.	Q2	
Fleet Services - Management, Maintenance and Administration	Review of the processes and controls around maintenance of fleet vehicles, including maintenance life-cycle, repairs, quality of services provided and management of warranties.		X
Corporate Relations			
First Nations - Land Access and Permitting	Assess the effectiveness of controls in obtaining and maintaining access rights and permits for Hydro One assets on First Nations properties. Review controls around valuation of Real Estate on FN properties and assess their fairness and adequacy.		X
Disclosures - Hydro One websites	Review of controls over material published on Hydro One external and internal websites to ensure adequacy, accuracy and compliance to laws and regulations, and Hydro One's disclosure policy.		X

REVIEW AREA	SCOPE OF WORK	2016	2017
Finance			
Corporate Scorecard - Process Review	Review the design and operating effectiveness of the Corporate Scorecard Process. Assess propriety of methodology underlying the metrics used in the scorecard (data capture, inclusions, exclusions).	Q3	
Financial Statement Consolidation Implementation - Project Review	Review project controls for the Financial Statement Consolidation initiative, including user requirements, decision documentation, testing and organizational change management. Assess the adequacy of the automation tool in providing accuracy, completeness and visibility into the inter-company balances and transactions.	Q3	
Purchasing Cards	Review the effectiveness of processes and controls around the use and management of Purchasing Cards at Hydro One.		X
Senior Executive Expenses 2016	Perform a compliance review of Senior Executive expenses at Hydro One, to ensure that expenses are in accordance with company prescriptive guidance.	Q2	
Senior Executive Expenses 2017	Perform a compliance review of Senior Executive expenses at Hydro One, to ensure that expenses are in accordance with company prescriptive guidance.		X
Corporate Scorecard - QA	QA review of compliance to the Corporate Scorecard for the period July 2015 - December 2015.	Q1	
Taxation - Personal Use of Hydro One Vehicles	Review the effectiveness of processes and controls around capturing personal use of Hydro One vehicles and the accounting of such activities.	Q2	
Personnel Costs - Savings analysis	Perform analytical review of payroll costs, focus on areas of cost management including recurring overtime, absenteeism and compare to industry benchmarks.		X
Business Planning Process Review	Assess the efficiency and effectiveness of the current business planning process, with a focus on clear accountabilities, quality of information, accuracy of processing and outputs, opportunities for process improvement and adequacy of the documentation and support.		X
Major Projects - Applications and Permits	Review of the process around obtaining applications and permits for major projects. Specific to Real Estate projects assess the effectiveness of the processes to identify, plan and execute acquisition (purchases, leases and rights of way) of land for lines and stations, as well as maintaining / renewing Rights of Way and permits.		X
Inergi Services - Payroll	Review the effectiveness of processes and controls around the payroll process at Inergi and the related management process at Hydro One corporate.		X
Treasury - Wire Transfers and Disbursements	Review effectiveness of controls around wire transfers and the TD online web banking process. Test the controls around manual and system generated cheques. Review controls around interest payments on Bonds.	Q3	
Management Assistance - Rate Application Quality Assurance	As specified by Regulatory Affairs management.	Q2	
Pensions			
Pensions - Cash Management	Review the effectiveness of processes and controls for managing the movement of cash in and out of the Hydro One Pension Fund. Assess controls related to managing the flow of cash between the Fund bank accounts and the Hydro One Payroll Bank accounts.		X

REVIEW AREA	SCOPE OF WORK	2016	2017
Information Technology			
SAP Data Integrity Follow-up	Perform a follow-up review of the 2012/2013 SAP Data Integrity audit and assess the status of the action plans.	Q3	
Data Governance	Review data governance processes, including change control and use of data that drive corporate strategic objectives, business and investment planning and asset management.		X
Inergi Services - IT	Review the effectiveness of processes and controls around the outsourced IT processes at Inergi and the process at Hydro One to measure their success.	Q3	
Corporate Projects			
Move to Mobile Project Review 2016	Review project controls for the Move to Mobile initiative, including user requirements, decision documentation, testing and organizational change management. Assess effectiveness of the technical integration of systems and processes.	Q1	
Move to Mobile Project Review 2017	Review project controls for the Move to Mobile initiative, including user requirements, decision documentation, testing and organizational change management. Assess effectiveness of the technical integration of systems and processes.		X
Security			
Cyber and Physical protection audit (NERC CIP processes) - Follow-up	Perform a follow-up review of the 2015 Cyber and Physical protection audit and assess the completion status of the action plans.	Q2	
Penetration Testing	Review effectiveness of processes and controls around the ISD Attack and Penetration testing program.	Q4	
Internet Security	Review Internet Security controls, including firewalls, ports and configuration settings, to assess the effectiveness of mitigating the risk of external attacks from the internet and/or e-mail and radicalized groups.	Q4	
OGCC/Power System Security Procedures	Perform a physical vulnerability assessment at OGCC, Richview Backup Control Center and other power system control locations (TBD), to identify security weaknesses that could be exploited to circumvent access control protocols, by-pass authentication, manipulate business processes and/or gain access to the GRID, sensitive information.		X
IT Security Governance	Assess the effectiveness of management controls in IT Security for optimizing risks and resources to ensure optimal delivery of services in a transparent manner.		X
Security Event Management	Review the security event management (SEM) programs over corporate systems and power systems intended to mitigate risks of unauthorized activity on Hydro One computer networks and devices.		X
Physical Security at Transmission Stations (TS)	Review the effectiveness of Access controls over physical security at Transmission Stations to assess their design adequacy and effectiveness including ongoing monitoring. Include controls intended to provide for public safety in and around the transmission stations.		X
Business Continuity / Resilience	Review effectiveness of processes and controls around Business Continuity that ensure the company is resilient to disruptions, has robust processes to ensure ongoing recovery of critical business functionality and contingency plans that are continually monitored and tested.	Q4	

REVIEW AREA	SCOPE OF WORK	2016	2017
Security Outsourcing Contract Management	Perform a Contract management and compliance review of key contracts such as TYCO or Guard Services.		X
People and Culture			
Succession Planning	Review processes and controls around succession planning and assess the effectiveness with which knowledge transfer, retention of key staff positions and adequate training ensure the identification and development of internal people with the potential to fill key business leadership positions in the company.	Q3	
Temporary Staff and Contractors - Cost/Benefit and Management	Review temporary staff /contractors hiring procedures and assess the effectiveness of controls in place to minimize over-reliance on contractors. Review processes around how the cost/benefit of these arrangements are assessed.		X
Health, Safety and Environment			
Integrated HSE Management System and Compliance Audit Program 2016	Perform audits to ensure compliance with internal Health, Safety and Environment Management System, OHSAS 18001 registration and Safety / Environment regulations.	Q1	
Integrated HSE Management System and Compliance Audit Program 2017	Perform audits to ensure compliance with internal Health, Safety and Environment Management System, OHSAS 18001 registration and Safety / Environment regulations.		X
Safety Incident Corrective/Preventive Action and Effectiveness Reviews	Review processes and controls related to the Safety and Environmental Incident Corrective/Preventive Action and Effectiveness Reviews. Perform a follow-up audit of the 2015 Safety Incident Management Audit.		X
Off-Road Vehicle Management and Safety	Review process and controls for managing Off-Road vehicle safety, including a review of vehicle inspection and maintenance requirements. Include a review of controls around licensing, inventory management and lifecycle management of these vehicles.	Q2	
Safety and Environmental Regulatory Framework	Review process and controls related to identifying and interpreting regulatory requirements to ensure business impacts are adequately assessed and internalized.	Q1	
Public Safety Initiatives Review	Review effectiveness of processes and controls for Public Safety and Work Site Security, including reviewing Reg 22/04 related to Construction / Provincial Lines project work sites (ie. Right of Way work sites).	Q3	
Contractor Safety Review	Assess process and controls related to safety (and environmental) performance of contractors working on behalf of Hydro One.		X
Safety: Confined Space	Assess safety protocols associated with working in confined spaces.	Q2	
Moving of Heavy Equipment	Assess safety protocols associated with moving Heavy Equipment.		X

REVIEW AREA	SCOPE OF WORK	2016	2017
Environment - PCB Management	Assess the controls in place to ensure compliance with the Federal PCB Regulation and internal SP 1281 PCB Management Plan requiring PCB phase-out by 2025. Assess the adequacy of cost forecasts, resource allocation plans to meet these stringent requirements.		X
Road Side Traffic Safety	Assess effectiveness of process and controls related to workplace safety associated with road-side work.	Q4	
Provincial Lines - Locate Services and Below Grade Excavation Activities	Assess effectiveness of safety controls associated with Provincial Lines' Below Grade excavation activities and underground Locate service provider contract management.	Q3	
Operations - Stations, Lines and Forestry			
Forestry Work Program	End-to-end review of Forestry Work Program to assess effectiveness of Work Program development, release and completion, and compliance with Standards.		X
Mobile Unit Substations	Review controls around the management of Mobile Unit Substations equipment.		X
Operations - Engineering / Construction			
Project Cost Estimates and Cost Control	Review the effectiveness of processes and controls around Capital Project Governance.	Q2	
Engineering Outsourcing Contract Management	Review the management process over the sourcing and awarding of contracts, including compliance with the Supplier Code of Ethics. Also review the process around ensuring contractors are properly qualified.	Q1	
Clarington Project Review Follow-up	Perform a follow-up review of the 2015 - Clarington Project Review and assess the status of the assigned action plans.		X
ISOC Project Review	Assess the adequacy of controls over procurement and contract services for the Integrated System Operating Control Center (ISOC) project, including processes around costing and scheduling. Review the work around the choice of the Business Centre focusing on function requirements and assess the effectiveness in minimizing unreliable delivery and/or disruption in the GRID.		X
Clarington - Billings Review	Review cost controls around management of Clarington construction billings. Review for unallowable charges for recovery, including the use of data analysis techniques.	Q4	
Project Scheduling	Review effectiveness of process and controls around Project Scheduling including the tools used to manage projects.		X
Project Quality Assurance and Commissioning	Review effectiveness of controls around the Project Quality and Commissioning process. Review how effective the process is in ensuring suitable quality in engineering design outputs and minimizing delays and re-work. Assess adequacy of the Enginnering Change Orders process.		X
Project Management - Procurement	Review the process around sourcing and awarding contracts including compliance to the Supplier Code of Conduct, for contractors within the Construction/Projects area. Review procedures related to inventory receipts, issues, storage and associated maintenance of inventory records, with focus on asphalt and aggregate materials.		X

REVIEW AREA	SCOPE OF WORK	2016	2017
IROV - Interim Report of Variance Follow-up	Perform a follow-up review of the 2015 IROV audit and assess the status of the action plans.		X
Operations - Tx/Dx Planning			
Asset Deployment Follow-up Review	Perform a follow-up review of the 2015 Asset Deployment audit, and assess the status of the action plans.	Q4	
Investment Plan - Governance / Delivery - Follow-up	Perform a follow-up review of the 2014 audit of Investment Planning and assess status of the action plans.		X
Projects and Programs	Review processes and controls over work bundling, accomplishment monitoring and variance reporting.		X
Asset Investment Plan / Analytics and other tools	Review the effectiveness of the Asset Investment Plan tool and the processes and controls around asset analytics used within the company. Review to be performed after the data governance audit.		X
Transmission Reliability Strategic Plan	Review the Transmission Reliability Strategic Planning process to assess the effectiveness with which initiatives, projects and programs are aligned to an overarching Transmission Reliability Strategy		X
Power Quality Management	Review the effectiveness of strategies and controls around the management of Power Quality including the interface and dependencies on other lines of business.		X
Operating Spares Management	Review the effectiveness of processes and controls around operating spares and the associated strategy around managing their utilization.	Q4	
Reliability Standards	Review the effectiveness of processes and controls around how Reliability Standards are maintained and have Best Practices are embedded in the process.		X
Large Customers - Connection Costs Estimates and Control	Review the controls around the process of data capture and verification of Tx, Dx and DG connection estimates and costs. Assess the effectiveness of how management monitors the actual to budgeted connection costs and revenues variances.	Q4	
Operations - Outsourcing			
Inergi - Outsourcing Model Framework and Contract Management	Perform a review of the Outsourcing Model Framework specific to Inergi, and assess the effectiveness of established performance measures, engagement and customer satisfaction.		X
Hydro One Remotes			
Generator Station Emergency Preparedness and Contingency Plan	Review the effectiveness of processes and controls related to the Generator Station Emergency and Preparedness Contingency Plan (GS EPCP). Assess its effectiveness in minimizing disruption or unreliable delivery of power.		X

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #002

Reference:

Office of the Auditor General Report, 2015 Annual Report, Chapter 3, Reports on Value-for-money Audits, Section 3.06 Hydro One – Management of Distribution and Transmission Assets

Interrogatory:

Preamble: The Auditor General's Report regarding Hydro One contains 17 recommendations.

a) Please explain how Hydro One has addressed the requirements of each of the 17 recommendations in the current application……replacing non high risk assets/internal audits

Response:

a) Please see Board Staff IR #2, I-01-002.

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #003

Reference:

Exhibit A, Tab 3, Schedule 1 Page 4 Table 1: Hydro One's Values and Business Objectives

Interrogatory:

Preamble: Under System Reliability, Hydro One's business objective is to maintain top quartile reliability relative to transmission peers.

a) Please provide the target range for T-SAIFI, T-SAIDI and T-SAIFI-M that reflects top quartile reliability for 2016, 2017 and 2018 relative to Hydro One's transmission peers.

Response:

Hydro One uses Transmission System Average Interruption Duration Index for multi-circuit supplied delivery points (T-SAIDI-mc) as the measure to compare its transmission reliability performance to its transmission peers in Canada. The T-SAIDI-mc target for the upcoming years, based on normal operating conditions and historical peers' performance, is set to be between 10 to 13 minutes.

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #004

Reference:

Exhibit A Tab 3 Schedule 1 Page 5

Interrogatory:

a) Please summarize the types of investments in the current application that are likely to impact transmission system reliability risk and actual system performance.

Response:

Refer to Exhibit B1, Tab 2, Schedule 4, Page 3, Figure 1. The investments that are likely to impact transmission reliability and actual system performance can be summarized in 3 groups:

1) Line refurbishments and CP/COB insulator replacements, driven by deteriorated conductor and insulator conditions. Failure of these assets often leads to line drops and forced outages.

2) Air Blast Circuit Breaker (ABCB) replacements. ABCBs are the most unreliable and worst performing breakers within Hydro One's transmission system. Refer to Exhibit B1, Tab 2, Schedule 6, Page 15, Figure 10.

3) Station investments, driven mainly by end of life transformers affecting reliability.

These 3 groups represent the most impactive assets i.e., lines, breakers and transformers, to reliability risk and system performance.

Details of these investments are described in Exhibit B1, Tab 3, Schedule 2.

Witness: Mike Penstone

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #005

Reference:

Exhibit A Tab 3 Schedule 1 Page 6

Interrogatory:

Preamble: Hydro One indicates it has modified its asset management approach to include reliability risk and its approach has been informed by the development of this approach in other jurisdictions.

a) Please provide a summary of the other jurisdictions that have developed this approach.

Response:

Hydro One understands a similar methodology is being developed and used in the UK under the Office Of Gas and Electricity Markets (OFGEM).

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #006

Reference:

None

Interrogatory:

a) Please provide a breakdown of Hydro One's projections regarding payroll and non-payroll costs related to the implementation of the government's Cap and Trade policy for the years 2016 to 2018.

b) Have any Cap and Trade costs been included in the current application? If yes, please provide.

Response:

a) Currently there are no known payroll costs related to the implementation of the government's Cap and Trade policy for 2016 to 2018. To buy the credits for SF6 emissions only for 2017, Hydro One is forecasting a cost of $1 million dollars.

b) The regulations relating to Ontario's Cap and Trade policy came out in June 2016 and information on how the system works is still emerging. As Hydro One submitted its rate application in May 2016, no Cap and Trade costs were included in the application.

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #007

Reference:

Exhibit A, Tab 3, Schedule 1 Section 5 Pages 15 to 17

Interrogatory:

a) Please explain why is there a performance metric for connection assessment of renewable energy projects, but not for load customer projects?

Response:

a) Hydro One has determined that a measure to monitor on-time performance of connections for renewable projects assists in adding focus to this area, thus helping to align activities with the fulfilment of government objectives. For this reason, this measure is proposed under the RRFE principle of Policy Response.

Overall, the transmission system has a relatively small number of directly-connected customers. Hydro One's OEB-approved Customer Connection Procedures and the associated connection requirements for load customers in the Transmission System Code are well-established relative to the newer processes for connecting renewable generation. As such, including a metric on the timeliness of connection impact assessments on these mature processes for such a small population on an annual basis would not provide incremental benefit. Hydro One relies on its ongoing business communications with load customers and on its formal surveys of customers to monitor the performance of load connection processes.

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #008

Reference:

Exhibit B1, Tab 1, Schedule 2

Interrogatory:

a) Please complete the following table:

	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total # of Tx assets									
% of Tx assets operating beyond Expected Service Life									

Response:

Hydro One only tracks this information for the categories of assets described in Exhibit B1, Tab 2, Schedule 6. For this reason, the information requested is unavailable. This information is provided on an asset category basis in Exhibit B1, Tab 2, Schedule 6.

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #009

Reference:

Exhibit B1 Tab 1 Schedule 2

Interrogatory:

Preamble: The new definition of Bulk Electric System (BES) (March 24, 2014) significantly expands the scope of power system elements that are subject to NERC's reliability standards.

a) Please provide the number of transmission elements captured by the new BES definition compared to prior.

b) Please provide the incremental costs due to the changed BES definition taking into account the reduced compliance requirements for 111 BES elements.

Response:

a) Prior to the new BES definition, approximately 330 transmission elements were subject to NERC standards. Following the new BES definition, there are approximately 275 additional transmission elements that are subject to NERC standards.

b) Taking into account the reduced compliance requirements for 111 BES elements, the estimated incremental costs attributable to the new BES definition are about $15 million in O&M costs and $20 million in capital costs over the test years.

Witness: Bing Young

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #010

Reference:

Exhibit B1 Tab 1 Schedule 2

Interrogatory:

a) Please identify and explain any new or revised engineering design and construction standards and/or specifications implemented since Hydro One's last Cost of Service application.

b) Please discuss the cost impact of any new or changed engineering design and construction standards and/or specifications in the current application

Response:

a) Hydro One has an active program to create and maintain the standards that are used to execute the Transmission Capital work program in a safe, reliable and cost effective manner. Between January 1, 2014 and June 30, 2016, there were a total of 242 design standards and equipment and material standards published affecting the transmission system. Another 37 design standards are planned to be published by year-end 2016. See Attachment #1 for the list of standards. These standards cover all areas of the transmission system across transmission lines, substations, and the systems that provide protection and control functionality across the transmission system.

b) Standards drive consistency and repeatability across a portfolio of capital projects. This in turn controls costs associated with design, construction, commissioning and on-going operations & maintenance.

Standard #	Standard Name	Last Published Date	Discipline
SS-65107-002	Medium Voltage Shunt Capacitor Banks for Outdoor Open Rack Mounting & Metal Enclosed Type	8/8/2016	Stations
PS-66400-001	Technical Specification for GPS Synchronized Clock	8/3/2016	P&C
SS-22000-001	Technical Specifications of PC&T in a Box for DESN Stations	7/28/2016	Stations
PD-60400-001	PCT Drawing Package V4.2	7/28/2016	P&C
SD-57500-001	Substation Control & Service Cable Raceway System	7/28/2016	Stations
CD-60251-001	Physical Security Design Standard for Medium Impact Facilities PCT Buildings	7/25/2016	Telecom
PD-65401-004	General Design Requirements for Autotransformer Protection	6/28/2016	P&C
PD-65401-005	HV Autotransformer Protection A Protection Application Guidelines Using the GE T60	6/28/2016	P&C
PD-65401-006	Autotransformer ‘B’ Protection Application Guidelines Using Siemens 7UT633	6/28/2016	P&C
PD-65105-004	Master Ground Protection Application Design Standard using C60 for "A" Protection and SEL-351-7 for "B" Protection	6/22/2016	P&C
SS-51030-001	Technical Specification for Outdoor High Voltage Circuit Breakers	6/1/2016	Stations
SS-51030-002	Technical Specification for Outdoor Medium Voltage Circuit Breakers	6/1/2016	Stations
PD-65109-005	Design Standard for Line End Open & O/V Protection Using the SEL-451-5	6/1/2016	P&C
SS-54020-002	Supplementary Technical Specification for Station Service Transformers (SSTx)	5/20/2016	Stations
SS-25000-001	Design Specification, Requirements for Ordering and Q/A Testing of Concrete Mixes	5/19/2016	Stations
SS-16100-001	Hot-Mix, Hot-Laid Asphalt Pavement	5/16/2016	Stations
PD-60224-003	Application Standard for Ethernet Switch - Siemens RuggedCom RX1500/RX1501	4/30/2016	P&C
PD-60225-001	Design Standard for SCADA Router	4/29/2016	P&C
PD-60225-002	Application Standard for SCADA Router - Cisco CGR2010	4/29/2016	P&C
PD-60224-004	Application Standard for Terminal Server - Rugged Server RS910	4/29/2016	P&C
PD-60224-005	Application Standard for Ethernet Switch - Siemens RuggedCom RSG2100/RSG2200	4/29/2016	P&C
PD-60224-025	CIP Validation for Ethernet Switch - Siemens RuggedCom RX1500/RX1501	4/29/2016	P&C
PD-60224-026	CIP Validation Test for Ethernet Switch - Siemens RuggedCom RSG2100/RS2200/RS900	4/29/2016	P&C
PD-60224-028	CIP Validation for RuggedCOM RS910	4/29/2016	P&C
PD-60224-029	Security Addendum for Siemens RuggedCom RS900	4/29/2016	P&C
PD-60225-003	Application Standard for Router - Belden GarrettCom Dymec DS1500 Router	4/29/2016	P&C

Standard #	Standard Type	Status	Published By (Group)	CSP#
SS-65107-002	Equipment and Material	Published	ENG-EESNT	CSP-1649
PS-66400-001	Equipment and Material	Published	ENG-EESNT	CSP-1657
SS-22000-001	Equipment and Material	Published	ENG-EESNT	CSP-1684
PD-60400-001	Design	Published	ENG-EESNT	CSP-1685
SD-57500-001	Design	Published	ENG-EESNT	CSP-1450
CD-60251-001	Design	Published	TELECOM	CSP-1514 / CSP-1632
PD-65401-004	Design	Published	ENG-EESNT	CSP-0529-ESC
PD-65401-005	Design	Published	ENG-EESNT	CSP-0530-ESC
PD-65401-006	Design	Published	ENG-EESNT	CSP-0531-ESC
PD-65105-004	Design	Published	ENG-EESNT	CSP-679d-ESC
SS-51030-001	Equipment and Material	Published	ENG-EESNT	CSP-1613
SS-51030-002	Equipment and Material	Published	ENG-EESNT	CSP-1614
PD-65109-005	Design	Published	ENG-EESNT	CSP-0124-ESC
SS-54020-002	Equipment and Material	Published	ENG-EESNT	CSP-1647
SS-25000-001	Equipment and Material	Published	ENG-STATION	CSP-1630
SS-16100-001	Equipment and Material	Published	ENG-STATION	CSP-1628
PD-60224-003	Design	Published	ENG-EESNT	BESCSI
PD-60225-001	Design	Published	ENG-EESNT	BESCSI
PD-60225-002	Design	Published	ENG-EESNT	BESCSI
PD-60224-004	Design	Published	ENG-EESNT	BESCSI
PD-60224-005	Design	Published	ENG-EESNT	BESCSI
PD-60224-025	Design	Published	ENG-EESNT	BESCSI
PD-60224-026	Design	Published	ENG-EESNT	BESCSI
PD-60224-028	Design	Published	ENG-EESNT	BESCSI
PD-60224-029	Design	Published	ENG-EESNT	BESCSI
PD-60225-003	Design	Published	ENG-EESNT	BESCSI

Standard #	Standard Name	Last Published Date	Discipline
PD-60225-004	CIP Validation for Router - Belden GarrettCom Dynastar Dymec DS1500	4/29/2016	P&C
PD-60225-005	CIP Validation for Router -- Siemens RuggedCom RX1100	4/29/2016	P&C
PD-60225-006	CIP Validation for SCADA Router - Cisco CGR2010 & ESM	4/29/2016	P&C
PD-60225-007	Application Standard for Router - Siemens RuggedCom RX1100	4/29/2016	P&C
PD-65000-001	Security Addendum for Siemens 7SA522, 7UT613, 7UT633	4/29/2016	P&C
PD-65000-002	CIP Validation for Siemens 7SA522, 7UT613, 7UT633	4/29/2016	P&C
PD-65000-003	Security Addendum for SEL-421-0, SEL-421-3, SEL-451-2, SEL-487B	4/29/2016	P&C
PD-65000-004	CIP Validation for SEL-421-3, SEL-451-2, SEL-487B	4/29/2016	P&C
PD-65000-005	Security Addendum for GE UR Relays (5.7x, 5.8x)	4/29/2016	P&C
PD-65000-006	Security Addendum for SEL-2440	4/29/2016	P&C
PD-65000-007	CIP Validation for GE UR Relays (5.7x, 5.8x)	4/29/2016	P&C
PD-65000-008	CIP Validation for SEL-2440	4/29/2016	P&C
PD-65000-009	Security Addendum for GE UR Relays (2.6x, 3.3x, 3.4x, 4.8x)	4/29/2016	P&C
PD-65000-010	CIP Validation for GE UR Relays (2.6x, 3.3x, 3.4x, 4.8x)	4/29/2016	P&C
PD-65000-011	Security Addendum for SEL-352-1	4/29/2016	P&C
PD-65000-012	Security Addendum for SEL-421-5, SEL-451-5, SEL-487B-1	4/29/2016	P&C
PD-65000-013	Security Addendum for SEL-351A (R5xx) and SEL 351-7 (R5xx)	4/29/2016	P&C
PD-65000-014	CIP Validation for SEL-352-1	4/29/2016	P&C
PD-65000-015	CIP Validation for SEL-421-5, SEL-451-5, SEL-487B-1	4/29/2016	P&C
PD-65000-016	CIP Validation for SEL-351A (R5xx) and SEL 351-7 (R5xx)	4/29/2016	P&C
PD-65000-017	Security Addendum for SEL-2020 and SEL-2030	4/29/2016	P&C
PD-65000-033	Security Addendum for ABB CAT Controller	4/29/2016	P&C
PD-65000-018	CIP Validation for SEL-2020 and SEL-2030	4/29/2016	P&C
PD-65000-019	Security Addendum for SEL-251-1	4/29/2016	P&C
PD-65000-020	Security Addendum for NXTPhase L-PRO 2100	4/29/2016	P&C
PD-65000-021	CIP Validation for SEL-251-1	4/29/2016	P&C
PD-65000-022	CIP Validation for NXTPhase L-PRO 2100	4/29/2016	P&C
PD-65000-023	Security Addendum for SEL-DTA2	4/29/2016	P&C
PD-65000-024	CIP Validation for SEL-DTA2	4/29/2016	P&C
PD-65000-025	Security Addendum for SEL-311L-1, SEL-321-1, SEL-351A(R1xx, R4xx), SEL-351-7(R3xx)	4/29/2016	P&C
PD-65000-026	Security Addendum for SEL-501-1	4/29/2016	P&C
	Technical Specification for Porcelain Post Insulators		**Stations**

Standard #	Standard Type	Status	Published By (Group)	CSP#
PD-60225-004	Design	Published	ENG-EESNT	BESCSI
PD-60225-005	Design	Published	ENG-EESNT	BESCSI
PD-60225-006	Design	Published	ENG-EESNT	BESCSI
PD-60225-007	Design	Published	ENG-EESNT	BESCSI
PD-65000-001	Design	Published	ENG-EESNT	BESCSI
PD-65000-002	Design	Published	ENG-EESNT	BESCSI
PD-65000-003	Design	Published	ENG-EESNT	BESCSI
PD-65000-004	Design	Published	ENG-EESNT	BESCSI
PD-65000-005	Design	Published	ENG-EESNT	BESCSI
PD-65000-006	Design	Published	ENG-EESNT	BESCSI
PD-65000-007	Design	Published	ENG-EESNT	BESCSI
PD-65000-008	Design	Published	ENG-EESNT	BESCSI
PD-65000-009	Design	Published	ENG-EESNT	BESCSI
PD-65000-010	Design	Published	ENG-EESNT	BESCSI
PD-65000-011	Design	Published	ENG-EESNT	BESCSI
PD-65000-012	Design	Published	ENG-EESNT	BESCSI
PD-65000-013	Design	Published	ENG-EESNT	BESCSI
PD-65000-014	Design	Published	ENG-EESNT	BESCSI
PD-65000-015	Design	Published	ENG-EESNT	BESCSI
PD-65000-016	Design	Published	ENG-EESNT	BESCSI
PD-65000-017	Design	Published	ENG-EESNT	BESCSI
PD-65000-033	Design	Published	ENG-EESNT	BESCSI
PD-65000-018	Design	Published	ENG-EESNT	BESCSI
PD-65000-019	Design	Published	ENG-EESNT	BESCSI
PD-65000-020	Design	Published	ENG-EESNT	BESCSI
PD-65000-021	Design	Published	ENG-EESNT	BESCSI
PD-65000-022	Design	Published	ENG-EESNT	BESCSI
PD-65000-023	Design	Published	ENG-EESNT	BESCSI
PD-65000-024	Design	Published	ENG-EESNT	BESCSI
PD-65000-025	Design	Published	ENG-EESNT	BESCSI
PD-65000-026	Design	Published	ENG-EESNT	BESCSI
	Equipment and Material	**PENDING PUBLICATION 2016**	**ENG-EESNT**	**CSP-1625**

Standard #	Standard Name	Last Published Date	Discipline
	Technical Specification for RTU		**P&C**
	Technical Specification for LCC		**P&C**
	Technical Specification for KVM		**P&C**
	Technical Specification for HMI software		**P&C**
	Technical Specification for Optical Ground Wire (OPGW)		**Lines**
	Technical Specification of Metering Cabinet & Cabinet Assemblies		**Metering**
PD-65000-027	Security Addendum for GE SR 745 Relays	4/29/2016	P&C
PD-65000-028	CIP Validation for SEL-311L-1, SEL-321-1, SEL-351A(R1xx, R4xx), SEL-351-7(R3xx)	4/29/2016	P&C
PD-65000-029	CIP Validation for SEL-501-1	4/29/2016	P&C
PD-65000-030	CIP Validation for GE SR 745 Relays	4/29/2016	P&C
PD-65000-031	Security Addendum for Siemens 7UT513	4/29/2016	P&C
PD-65000-032	Security Addendum for ABB REL-521	4/29/2016	P&C
PD-66450-003	Application Standard for Eaton Cooper SMP16 Station Gateway	4/29/2016	P&C
PD-66450-004	CIP Validation for GE D20 and D200 RTU	4/29/2016	P&C
PD-66450-005	Security Addendum for GE D20/D200	4/29/2016	P&C
PD-66450-006	Application Standard for Eaton Cooper SMP16 Event Gateway	4/29/2016	P&C
PD-66450-007	CIP Validation for Eaton Cooper SMP16 Event Gateway	4/29/2016	P&C
PD-66450-008	Application Standard for Eaton Cooper SMP16 Hub Gateway	4/29/2016	P&C
PD-66450-009	CIP Validation for Eaton Cooper SMP16 Hub Gateway	4/29/2016	P&C
PD-66450-010	CIP Validation for Eaton Cooper SMP16 Station Gateway	4/29/2016	P&C
PD-66450-011	CIP Validation for GE D25 RTU	4/29/2016	P&C
PD-66450-012	Security Addendum for GE D25	4/29/2016	P&C
PD-66450-013	Security Addendum for Eaton Cooper SMP4 Distribution Station Gateway	4/29/2016	P&C
PD-66450-015	CIP Validation for Eaton Cooper SMP4 Distribution Station Gateway	4/29/2016	P&C
PD-66450-017	Application Standard for Eaton Cooper SMP I/O	4/29/2016	P&C
PD-66450-018	CIP Validation for Eaton Cooper SMP I/O	4/29/2016	P&C
PD-66450-019	Cyber Integrated Remote site Technical Design	4/29/2016	P&C
PD-66450-020	Application Standard for Eaton Cooper IED Manager Suite (IMS)	4/29/2016	P&C
PD-66450-021	CIP Validation for Eaton Cooper IED Manager Suite (IMS)	4/29/2016	P&C
PD-69100-001	Security Addendum for SEL-3354 LCC and LMC	4/29/2016	P&C
PD-69100-002	CIP Validation for SEL-3354 LCC and LMC	4/29/2016	P&C
PD-69100-003	CIP Validation for SMP16 LCC	4/29/2016	P&C
PD-69100-004	Security Addendum for SMP16 LCC	4/29/2016	P&C

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	Equipment and Material	PENDING PUBLICATION 2016	ENG-EESNT	CSP-1653
	Equipment and Material	PENDING PUBLICATION 2016	ENG-EESNT	CSP-1656
	Equipment and Material	PENDING PUBLICATION 2016	ENG-EESNT	CSP-1658
	Equipment and Material	PENDING PUBLICATION 2016	ENG-EESNT	CSP-1659
	Equipment and Material	PENDING PUBLICATION 2016	ENG-LINES	CSP-1682
	Equipment and Material	PENDING PUBLICATION 2016	ENG-EESNT	CSP-1702
PD-65000-027	Design	Published	ENG-EESNT	BESCSI
PD-65000-028	Design	Published	ENG-EESNT	BESCSI
PD-65000-029	Design	Published	ENG-EESNT	BESCSI
PD-65000-030	Design	Published	ENG-EESNT	BESCSI
PD-65000-031	Design	Published	ENG-EESNT	BESCSI
PD-65000-032	Design	Published	ENG-EESNT	BESCSI
PD-66450-003	Design	Published	ENG-EESNT	BESCSI
PD-66450-004	Design	Published	ENG-EESNT	BESCSI
PD-66450-005	Design	Published	ENG-EESNT	BESCSI
PD-66450-006	Design	Published	ENG-EESNT	BESCSI
PD-66450-007	Design	Published	ENG-EESNT	BESCSI
PD-66450-008	Design	Published	ENG-EESNT	BESCSI
PD-66450-009	Design	Published	ENG-EESNT	BESCSI
PD-66450-010	Design	Published	ENG-EESNT	BESCSI
PD-66450-011	Design	Published	ENG-EESNT	BESCSI
PD-66450-012	Design	Published	ENG-EESNT	BESCSI
PD-66450-013	Design	Published	ENG-EESNT	BESCSI
PD-66450-015	Design	Published	ENG-EESNT	BESCSI
PD-66450-017	Design	Published	ENG-EESNT	BESCSI
PD-66450-018	Design	Published	ENG-EESNT	BESCSI
PD-66450-019	Design	Published	ENG-EESNT	BESCSI
PD-66450-020	Design	Published	ENG-EESNT	BESCSI
PD-66450-021	Design	Published	ENG-EESNT	BESCSI
PD-69100-001	Design	Published	ENG-EESNT	BESCSI
PD-69100-002	Design	Published	ENG-EESNT	BESCSI
PD-69100-003	Design	Published	ENG-EESNT	BESCSI
PD-69100-004	Design	Published	ENG-EESNT	BESCSI

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PD-69100-005	Security Addendum for SEL-3355 LCC and LMC	4/29/2016	P&C
PD-69100-006	CIP Validation for Stealth LCC and LMC	4/29/2016	P&C
PD-69100-007	Security Addendum for Stealth LCC and LMC	4/29/2016	P&C
PD-69100-008	CIP Validation for SEL-3355 LCC and LMC	4/29/2016	P&C
SD-55000-002	Design Guidelines for Selection & Sizing of DESN & BES Station Batteries	4/28/2016	Stations
PS-65100-002	Technical Specification for Intelligent Electronic Devices for Power System Protection, Control & Monitoring Applications	4/15/2016	P&C
PS-65100-001	Supplementary Proponent Requirements for the Supply of Intelligent Electronic Devices for Power System Protection, Control & Monitoring Applications	4/15/2016	P&C
PD-60224-002	Design Standard for Ethernet Switch	3/31/2016	P&C
PD-66450-002	Design Standard for SCADA Gateway	3/31/2016	P&C
PD-66450-014	Application Standard for Eaton Cooper SMP4 /DP Distribution Station Gateway	3/31/2016	P&C
PF-60224-003	Decommissioning Procedure for RuggedCOM ROS-based Devices	3/31/2016	P&C
PF-60224-004	Decommissioning Procedure for Ethernet Switch -- Siemens RuggedCom RX1500/RX1501	3/31/2016	P&C
PF-66450-005	Decommissioning Procedure for Eaton Cooper SMP4 Gateway	3/31/2016	P&C
PF-66450-004	Decommissioning Procedure for Eaton Cooper SMP I/O	3/31/2016	P&C
PF-69100-001	Decommissioning Procedure for SEL-3354 LCC and LMC	3/31/2016	P&C
PF-69100-002	Decommissioning Procedure for SMP16 LCC	3/31/2016	P&C
PF-69100-003	Decommissioning Procedure for Stealth LCC and LMC	3/31/2016	P&C
PF-69100-004	Decommissioning Procedure for SEL-3355 LCC and LMC	3/31/2016	P&C
PF-60225-001	Decommissioning Procedure for Router - Cisco CGR2010	3/31/2016	P&C
PF-60225-002	Decommissioning Procedure for Router -- Belden GarrettCom Dynastar Dymec DS1500	3/31/2016	P&C
PF-60225-003	Decommissioning Procedure for Router -- Siemens RuggedCom RX1100	3/31/2016	P&C
PF-65000-001	Decommissioning Procedure for Siemens 7SA522, 7UT613, 7UT633	3/31/2016	P&C
PF-65000-002	Decommissioning Procedure for SEL-421-3, SEL-451-2, SEL-487B	3/31/2016	P&C
PF-65000-003	Decommissioning Procedure for GE UR Relays (5.7x, 5.8x)	3/31/2016	P&C
PF-65000-004	Decommissioning Procedure for GE UR Relays (2.6x, 2.8x, 3.1x, 3.3x, 3.4x, 4.8x, 4.9x, 5.2x)	3/31/2016	P&C
PF-65000-005	Decommissioning Procedure for SEL-2440	3/31/2016	P&C
PF-65000-006	Decommissioning Procedure for SEL-421-5, SEL-451-5, SEL-487B-1	3/31/2016	P&C

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PD-69100-005	Design	Published	ENG-EESNT	BESCSI
PD-69100-006	Design	Published	ENG-EESNT	BESCSI
PD-69100-007	Design	Published	ENG-EESNT	BESCSI
PD-69100-008	Design	Published	ENG-EESNT	BESCSI
SD-55000-002	Design	Published	ENG-EESNT	CSP-1443
PS-65100-002	Equipment and Material	Published	ENG-EESNT	2015
PS-65100-001	Equipment and Material	Published	ENG-EESNT	2015
PD-60224-002	Design	Published	ENG-EESNT	2015
PD-66450-002	Design	Published	ENG-EESNT	2015
PD-66450-014	Design	Published	ENG-EESNT	2015
PF-60224-003	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-60224-004	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-66450-005	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-66450-004	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-69100-001	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-69100-002	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-69100-003	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-69100-004	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-60225-001	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-60225-002	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-60225-003	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-65000-001	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-65000-002	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-65000-003	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-65000-004	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-65000-005	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-65000-006	De-Commissioning	Published	ENG-EESNT	BESCSI

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PF-65000-007	Decommissioning Procedure for SEL-352-1	3/31/2016	P&C
PF-65000-008	Decommissioning Procedure for SEL-351A (R5xx) and SEL 351-7 (R5xx)	3/31/2016	P&C
PF-65000-009	Decommissioning Procedure for SEL-2020 and SEL-2030	3/31/2016	P&C
PF-65000-010	Decommissioning Procedure for SEL-251-1	3/31/2016	P&C
PF-65000-011	Decommissioning Procedure for NXTPhase L-PRO 2100	3/31/2016	P&C
PF-65000-012	Decommissioning Procedure for SEL-DTA2	3/31/2016	P&C
PF-65000-013	Decommissioning Procedure for for SEL-311L-1, SEL-321-1, SEL-351A(R1xx, R4xx), SEL-351-7(R3xx)	3/31/2016	P&C
PF-65000-014	Decommissioning Procedure for SEL-501-1	3/31/2016	P&C
CD-60226-002	GE JungleMux T1 Multiplexer Universal Teleprotection Design and Installation Standard	3/1/2016	Telecom
PF-65000-015	Decommissioning Procedure for GE SR 745 Relays	3/31/2016	P&C
PF-65000-016	Decommissioning Procedure for ABB CAT Controller	3/31/2016	P&C
PF-65000-017	Decommissioning Procedure for Siemens 7UT513	3/31/2016	P&C
PF-65000-018	Decommissioning Procedure for ABB REL-521	3/31/2016	P&C
PF-66450-001	Decommissioning Procedure for GE D20/D200 RTU	3/31/2016	P&C
CD-60226-003	GE JungleMux SONET Multiplexer at BES Transformer Station	2/1/2016	Telecom
CZ-60291-001	Assembly Details of the Fully-Equipped SNC 12-Slot Optical-Isolator Turnkey Modular Assembly in DESN Stations, utilizing PCT Buildings	2/1/2016	Telecom
CZ-60291-002	Installation Details for the SNC 12-Slot Optical-Isolator Turnkey Modular Assembly in DESN Stations, utilizing PCT Buildings	2/1/2016	Telecom
CD-60226-001	GE JungleMUX SONET Multiplexer at DESN TS Station	2/1/2016	Telecom
PF-66450-002	Decommissioning Procedure for GE D25 RTU	3/31/2016	P&C
PF-66450-003	Decommissioning Procedure for Eaton Cooper SMP16 Gateway	3/31/2016	P&C
PD-66000-002	Design Guidelines for Control Wiring within Switchyard	2/29/2016	P&C
SD-55000-001	Design Guidelines for Station Battery Installation	2/25/2016	Stations
PD-66000-003	Design Guidelines for Protection, Control, & Telecom Device Installation & Termination	2/17/2016	P&C
SD-12400-001	Transformer and Switching Stations Drainage	2/5/2016	Stations
LS-59300-001	Technical Specification for Optical Ground Wire (OPGW)	2/4/2016	Lines
PD-66000-001	Design Guideline for Control Wiring within Protection Control & Telecom Racks	1/21/2016	P&C

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PF-65000-007	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-65000-008	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-65000-009	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-65000-010	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-65000-011	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-65000-012	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-65000-013	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-65000-014	De-Commissioning	Published	ENG-EESNT	BESCSI
CD-60226-002	Design	Published	TELECOM	CSP-1328
PF-65000-015	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-65000-016	De-commissioning	Published	ENG-EESNT	BESCSI
PF-65000-017	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-65000-018	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-66450-001	De-Commissioning	Published	ENG-EESNT	BESCSI
CD-60226-003	Design	Published	TELECOM	CSP-0779
CZ-60291-001	Construction	Published	TELECOM	CSP-1501
CZ-60291-002	Construction	Published	TELECOM	CSP-1502
CD-60226-001	Design	Published	TELECOM	CSP-0758
PF-66450-002	De-Commissioning	Published	ENG-EESNT	BESCSI
PF-66450-003	De-Commissioning	Published	ENG-EESNT	BESCSI
PD-66000-002	Design	Published	ENG-EESNT	CSP-0409-ESC
SD-55000-001	Design	Published	ENG-EESNT	CSP-1442
PD-66000-003	Design	Published	ENG-EESNT	CSP-0410-ESC
SD-12400-001	Design	Published	ENG-STATION	CSP-1456
LS-59300-001	Equipment and Material	Published	ENG-LINES	2015
PD-66000-001	Design	Published	ENG-EESNT	CSP-0399-ESC

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LS-20150-001	Technical Specification for Anchor Bolts from Deformed Concrete Reinforcing Bar	1/19/2016	Lines
SS-10180-001	Technical Specification for Geotechnical Survey	1/14/2016	Stations
EO-83300-001	Environmental Site Assessment as a Component of a Geotechnical Investigation	1/14/2016	Environmental
CS-62810-001	PMR - Base Station Shelter Procurement	1/5/2016	Telecom
CD-60226-004	GE JungleMux SONET Multiplexer at a DESN TS PCT Type Building	12/22/2015	Telecom
CD-62810-001	PMR - Base Station Shelter Guideline	12/16/2015	Telecom
CS-60261-002	PCT BESMOD. Equiv. Telecom, 48 VDC 100AH Power Supply	12/10/2015	Telecom
CZ-60272-001	Installation Requirements for Free Wave Radio Cabinets & Antennas at Three Phase Recloser Sites	12/10/2015	Telecom
ED-81310-001	EA Guideline for Transmission Undertakings	1/14/2016	Environmental
PD-65105-003	LV Bus Blocking "B" Protection application design standard using the SEL-351-7	1/14/2016	P&C
PD-65109-006	High Voltage Line Protection Application Guideline using the GE D60 V5.71	1/14/2016	P&C
ED-84200-001	Environmental Monitoring	1/13/2016	Environmental
ED-82200-002	Coordination of a Class EA	1/13/2016	Environmental
ED-82200-003	Class Environmental Assessment - Coordination Guideline	1/13/2016	Environmental
DS-83-001	Technical Specification for Electronic Controllers for Reclosers	1/8/2016	P&C
PD-65107-002	HV Shunt Capacitor Bank ‘B’ Protection Application Design Standard Using the SEL-351A	12/9/2015	P&C
PD-65107-003	HV Shunt Capacitor Bank ‘A’ Protection Application Guideline Using the GE F60 (5.71)	12/9/2015	P&C
PD-65107-006	General HV Shunt Capacitor Bank Protection Design Requirements	12/9/2015	P&C
SS-54020-001	High Voltage Alternating Current (HVAC) Station Service Voltage Transformer (SSVT) Procurement Technical Specification	11/27/2015	Stations
SD-59000-001	Grounding Standard Drawings to Accommodate Copper Theft Prevention	11/23/2015	Stations
PD-65109-008	HV Line Protection Application Guideline Using the GE L90 (5.72)	11/23/2015	P&C
PD-65109-009	HV Line Protection Application Guideline Using the SEL-311L	11/23/2015	P&C
PD-65100-001	DESN Station LV Bus Local Islanding Detection Application Design Standard Using the SEL-2440	11/17/2015	P&C
PD-65100-002	Wide Area Anti-islanding Application Standard using the AXION	11/17/2015	P&C
SD-78000-001	Outdoor Fire Protection (Passive) Water System Design Procedures	11/10/2015	Stations

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LS-20150-001	Equipment and Material	Published	ENG-LINES	CSP-1471
SS-10180-001	Equipment and Material	Published	ENG-STATION	2015
EO-83300-001	Design	Published	ENG-ENVIRONMENTAL	2015
CS-62810-001	Equipment and Material	Published	TELECOM	2015
CD-60226-004	Design	Published	TELECOM	2015
CD-62810-001	Design	Published	TELECOM	2015
CS-60261-002	Equipment and Material	Published	TELECOM	2015
CZ-60272-001	Construction	Published	TELECOM	2015
ED-81310-001	Design	Published	ENG-ENVIRONMENTAL	2015
PD-65105-003	Design	Published	ENG-EESNT	2015
PD-65109-006	Design	Published	ENG-EESNT	2015
ED-84200-001	Design	Published	ENG-ENVIRONMENTAL	2015
ED-82200-002	Design	Published	ENG-ENVIRONMENTAL	2015
ED-82200-003	Design	Published	ENG-ENVIRONMENTAL	2015
DS-83-001	Equipment and Material	Published	ENG-EESNT	2015
PD-65107-002	Design	Published	ENG-EESNT	2015
PD-65107-003	Design	Published	ENG-EESNT	2015
PD-65107-006	Design	Published	ENG-EESNT	2015
SS-54020-001	Equipment and Material	Published	ENG-STATION	2015
SD-59000-001	Design	Published	ENG-STATION	2015
PD-65109-008	Design	Published	ENG-EESNT	2015
PD-65109-009	Design	Published	ENG-EESNT	2015
PD-65100-001	Design	Published	ENG-EESNT	2015
PD-65100-002	Design	Published	ENG-EESNT	2015
SD-78000-001	Design	Published	ENG-STATION	2015

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SD-16100-001	Design Requirements for Transmission and Switching Station Vehicle Access Routes and Parking Areas	11/10/2015	Stations
PS-66100-001	Technical Specification for Terminal Blocks	11/6/2015	P&C
SD-57112-001	Design Standard for Animal Cover Up	11/6/2015	Stations
SS-57112-001	Animal Cover-Up	10/16/2015	Stations
PD-66450-001	DESIGN STANDARD FOR BES STATION LAN	10/15/2015	P&C
SD-25407-001	Guidelines for Designing Sound Barrier Walls	10/2/2015	Stations
SD-14100-001	Design and Erection Standard for 2.4 m Chain Link Station Fencing	9/29/2015	Stations
LS-52012-001	Austenitic Stainless Steel Pipe for HPLF Cable Installations	9/25/2015	Lines
SD-12220-001	Transformer and Switching Station Finish Grading	9/22/2015	Stations
SS-16150-001	Requirement for Ordering and Q/A Testing of Fire Quenching and Station Surface Stone	9/21/2015	Stations
PD-65401-001	DESN Power Transformer and Line Backup 'B' Protection Application Guideline using the Siemens 7UT613 and SEL351-7	8/27/2015	P&C
PD-65401-002	DESN Power Transformer and Line Backup 'A' Protection Application Guideline using the GE T60	8/27/2015	P&C
SD-51300-002	Design Standard for 230kV 80kA Switchyard Rigid Bus	7/23/2015	Stations
SD-51020-001	Standard Requirement for Transformer Breaker Disconnect Switch	6/26/2015	Stations
SD-50000-002	Electrical Safety Clearances for Air Insulated Outdoor Stations	3/27/2015	Stations
CD-67000-001	Aviation Obstruction Lighting System for Transmission & Communication Towers	12/31/2014	Telecom
CD-60274-001	Installation of RFL DACS Equipment	12/23/2014	Telecom
PF-60224-002	Procedure for Decommissioning Of Dymec 1500/2000 Router	3/5/2015	P&C
DD-41-007	Retrofit Details for Typical Temporary Portable Grounding Attachment Arrangement on Air Insulated Medium Voltage Metal-Enclosed and MetalClad Switchgear at DS	1/23/2015	Stations
PD-66000-005	General Grounding Guidelines for Protection Control and Metering Equipment	1/18/2015	P&C
PS-66110-001	Technical Specification for Reversible Free-Standing Open Type Equipment Racks for 19" and 24" Equipment	1/16/2015	Stations
SS-55530-001	Tendering Document for 250 VDC Indoor Metal Enclosed Switchgear, Type H, Including Transfer Controls for Station Services Manual Transfer	1/7/2015	Stations
SD-27890-001	Transformer Fire Separation Requirement Standard	1/7/2015	Stations
SD-51300-001	Design Standard for 230kV 63kA Switchyard Rigid Bus	12/31/2014	Stations

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SD-16100-001	Design	Published	ENG-STATION	2015
PS-66100-001	Equipment and Material	Published	ENG-EESNT	2015
SD-57112-001	Design	Published	ENG-STATION	2015
SS-57112-001	Equipment and Material	Published	ENG-STATION	2015
PD-66450-001	Design	Published	ENG-EESNT	2015
SD-25407-001	Design	Published	ENG-STATION	2015
SD-14100-001	Design	Published	ENG-STATION	2015
LS-52012-001	Equipment and Material	Published	ENG-LINES	2015
SD-12220-001	Design	Published	ENG-STATION	2015
SS-16150-001	Equipment and Material	Published	ENG-STATION	2015
PD-65401-001	Design	Published	ENG-EESNT	2015
PD-65401-002	Design	Published	ENG-EESNT	2015
SD-51300-002	Design	Published	ENG-STATION	2015
SD-51020-001	Design	Published	ENG-STATION	2015
SD-50000-002	Design	Published	ENG-STATION	2015
CD-67000-001	Design	Published	TELECOM	2014
CD-60274-001	Design	Published	TELECOM	2014
PF-60224-002	De-Commissioning	Published	ENG-EESNT	2015
DD-41-007	Design	Published	ENG-EESNT	2015
PD-66000-005	Design	Published	ENG-EESNT	2015
PS-66110-001	Equipment and Material	Published	ENG-STATION	2015
SS-55530-001	Equipment and Material	Published	ENG-STATION	2015
SD-27890-001	Design	Published	ENG-STATION	2015
SD-51300-001	Design	Published	ENG-STATION	2014

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SD-51050-001	Guideline for Establishing Station Bus Ampacity	12/22/2014	Stations
EP-83100-001	Acquiring an Environmental Compliance Approval for Air and Noise Emissions	12/19/2014	Environmental
EP-83200-001	Acquiring an Environmental Compliance Approval for Industrial Sewage	12/19/2014	Environmental
EP-83400-001	Municipal Reviews & Permits Requirements	12/19/2014	Environmental
SS-51070-002	Technical Specification for Dry Type Air Core Series Reactor	12/19/2014	Stations
SS-51070-001	Technical Specification for Dry Type Air Core Shunt Reactors	12/19/2014	Stations
SS-51070-003	Technical Specification for Dry Type Air Core Neutral Grounding Reactors	12/19/2014	Stations
CD-60211-006	Digital Teleprotection using DSI Access Multiplexers	12/17/2014	Telecom
LS-51052-002	Steel Terminals for Dead-End Compression Connectors	12/19/2014	Lines
LS-51080-002	Technical Specification for AC Suspension Composite Insulators	12/19/2014	Lines
LS-52010-001	Cable and Accessories; Design, Supply and Installation of High Pressure-Pipe Type Cable Systems	12/19/2014	Lines
LS-52020-001	Cable, 115kV and 230kV, Self-Contained Fluid-Filled System	12/19/2014	Lines
LS-52030-001	Cable and Cable Accessories; Design, Supply and Installation of HV and EHV XLPE Insulated Cable Systems	12/19/2014	Lines
SD-51050-002	General Design and Installation Requirements for Rigid Bus	12/19/2014	Stations
DD-83-001	General Protection Design Requirements for 3 Phase Electronic Recloser Controllers	12/19/2014	P&C
PF-60224-001	Decommissioning Procedure for Ethernet Switch - Cisco CGS2520	12/17/2014	P&C
LS-51052-003	Technical Specification for Strain Link	12/12/2014	Lines
LS-51052-001	Technical Specification for Strain and Suspension Adapters	12/12/2014	Lines
DD-86-001	Distribution Transformer Automatic Voltage Controller Beckwith M-2001D Application Guideline	12/11/2014	P&C
SD-53300-001	Design Guidelines for 600 V AC Station Service for System Transmission Stations	12/11/2014	Stations
	Design Guideline AC Station Services for DESN Stations		**Stations**
	Design Guidelines DC Station Services for DESN Stations		**Stations**
TD-60420-001	**Design Standard for Power Quality Monitoring**		**P&C**
	NSD570 Digital Teleprotection Design and Installation Standard		**P&C**
SD-51080-001	**Leakage Distances for Post Insulators in 115 kV to 500 kV Substations**		**Stations**
	Application Standard Guideline for SEL-651-R2 Controller with Three Phase G&W Viper-ST Recloser		**P&C**
CS-60292-001	Fiber Patch Cord Assembly - Technical Specification	10/6/2014	Telecom

Standard #	Standard Type	Status	Published By (Group)	CSP#
SD-51050-001	Design	Published	ENG-STATION	2014
EP-83100-001	Functional	Published	ENG-ENVIRONMENTAL	2014
EP-83200-001	Functional	Published	ENG-ENVIRONMENTAL	2014
EP-83400-001	Functional	Published	ENG-ENVIRONMENTAL	2014
SS-51070-002	Equipment and Material	Published	ENG-STATION	2014
SS-51070-001	Equipment and Material	Published	ENG-STATION	2014
SS-51070-003	Equipment and Material	Published	ENG-STATION	2014
CD-60211-006	Design	Published	TELECOM	2014
LS-51052-002	Equipment and Material	Published	ENG-LINES	2014
LS-51080-002	Equipment and Material	Published	ENG-LINES	2014
LS-52010-001	Equipment and Material	Published	ENG-LINES	2014
LS-52020-001	Equipment and Material	Published	ENG-LINES	2014
LS-52030-001	Equipment and Material	Published	ENG-LINES	2014
SD-51050-002	Design	Published	ENG-STATION	2014
DD-83-001	Design	Published	ENG-EESNT	2014
PF-60224-001	De-Commissioning	Published	ENG-EESNT	2014
LS-51052-003	Equipment and Material	Published	ENG-LINES	2014
LS-51052-001	Equipment and Material	Published	ENG-LINES	2014
DD-86-001	Design	Published	ENG-EESNT	2014
SD-53300-001	Design	Published	ENG-STATION	2014
	Design	**PENDING PUBLICATION 2016**	**ENG-EESNT**	**CSP-0413**
	Design	**PENDING PUBLICATION 2016**	**ENG-EESNT**	**CSP-0414**
TD-60420-001	**Design**	**PENDING PUBLICATION 2016**	**ENG-EESNT**	**CSP-0675**
	Design	**PENDING PUBLICATION 2016**	**ENG-EESNT**	**CSP-1219**
SD-51080-001	**Design**	**PENDING PUBLICATION 2016**	**ENG-EESNT**	**CSP-1446**
	Design	**PENDING PUBLICATION 2016**	**ENG-EESNT**	**CSP-1606**
CS-60292-001	Equipment and Material	Published	TELECOM	2014

Standard #	Standard Name	Last Published Date	Discipline
	General Protection Design Requirements for Three Phase Electronic Recloser Controllers		P&C
	Overhead line clearances		Lines
	Medium Voltage Shunt Capacitor Banks Internally Fused for Outdoor Open-Rack Mounting and Metal Enclosed Type		P&C
	Application standard for EVENT Gateway		P&C
	Design Standard for DESN LAN		P&C
	Design Standard for BES LAN		P&C
	Security Perimeter Lighting		Stations
	Switchyard Lighting for Substations		Stations
	Design Standard for DME		P&C
	General Guideline for HV Line Protection		P&C
	General Guideline for Autotransformer		P&C
	General Guideline for HV Circuit Breaker		P&C
	Revision of Design and Erection Standard for 2.4 m Chain Link Station Fencing		Stations
	Revision of Design Guidelines for 600V AC Station Service for System Transmission Stations		Stations
PD-66450-016	Application Standard for Eaton Cooper SG 4250 Station Gateway		P&C
PD-66450-023	Application Standard for Eaton Cooper SG 4250Hub Gateway		P&C
PD-66450-024	CIP Validation for Station Gateway -Eaton SG 4250		P&C
PD-66450-025	CIP Validation for Hub Gateway -Eaton SG 4250		P&C
CS-67000-001	Aviation Obstruction Lighting Specification for Transmission Line Towers and Communication Towers	4/1/2014	Telecom
PD-66450-026	CIP Validation for Eaton Cooper SG 4250 Event Gateway		P&C
	Design Standard for Wholesale Revenue metering		Metering
	Design Standard for Station Service Metering		Metering
SS-51261-001	Technical Specification for Station Class Surge Arresters for HV and EHV Systems	12/10/2014	Stations
SS-51661-001	Station Class Surge Arresters for MV Systems	12/10/2014	Stations
PS-65401-002	Technical Specificatin - Transformer Online Dissolved Gas Analysis Monitoring Solution	12/10/2014	P&C

Standard #	Standard Type	Status	Published By (Group)	CSP#
	Design	PENDING PUBLICATION 2016	ENG-EESNT	CSP-1611
	Design	PENDING PUBLICATION 2016	ENG-LINES	CSP-1626
	Design	PENDING PUBLICATION 2016	ENG-EESNT	CSP-1648
	Design	PENDING PUBLICATION 2016	ENG-EESNT	CSP-1651
	Design	PENDING PUBLICATION 2016	ENG-EESNT	CSP-1654
	Design	PENDING PUBLICATION 2016	ENG-EESNT	CSP-1655
	Design	PENDING PUBLICATION 2016	ENG-EESNT	CSP-1660
	Design	PENDING PUBLICATION 2016	ENG-EESNT	CSP-1661
	Design	PENDING PUBLICATION 2016	ENG-EESNT	CSP-1662
	Design	PENDING PUBLICATION 2016	ENG-EESNT	CSP-1663
	Design	PENDING PUBLICATION 2016	ENG-EESNT	CSP-1668
	Design	PENDING PUBLICATION 2016	ENG-EESNT	CSP-1671
	Design	PENDING PUBLICATION 2016	ENG-STATION	CSP-1679
	Design	PENDING PUBLICATION 2016	ENG-EESNT	CSP-1683
PD-66450-016	Design	PENDING PUBLICATION 2016	ENG-EESNT	CSP-1694
PD-66450-023	Design	PENDING PUBLICATION 2016	ENG-EESNT	CSP-1695
PD-66450-024	Design	PENDING PUBLICATION 2016	ENG-EESNT	CSP-1696
PD-66450-025	Design	PENDING PUBLICATION 2016	ENG-EESNT	CSP-1697
CS-67000-001	Equipment and Material	Published	TELECOM	2014
PD-66450-026	Design	PENDING PUBLICATION 2016	ENG-EESNT	CSP-1698
	Design	PENDING PUBLICATION 2016	ENG-EESNT	CSP-1700
	Design	PENDING PUBLICATION 2016	ENG-EESNT	CSP-1701
SS-51261-001	Equipment and Material	Published	ENG-STATION	2014
SS-51661-001	Equipment and Material	Published	ENG-STATION	2014
PS-65401-002	Equipment and Material	Published	ENG-EESNT	2014

Standard #	Standard Name	Last Published Date	Discipline
LS-52043-001	Cable accessories; Design, Supply and Installation of 115 kV and 230 kV HPFF Pipe-Type, SCFF, and XLPE Cable Terminations for Direct Connection into Gas Insulated Substations (GIS)	11/28/2014	Lines
PD-65104-002	VT and CVT Application Guide	11/25/2014	P&C
SD-50000-001	Minimum Electrical Striking Distances for Air Insulated Bus in Stations	11/24/2014	Stations
EP-82200-001	Environmental Assessment Communications Plan	11/13/2014	Environmental
EP-83510-001	Telecommunications Antenna System Approval Process	11/13/2014	Environmental
DD-83-005	Application Guideline for Hubbell Versa-Tech Single-Phase Recloser	11/7/2014	P&C
	Design Requirements of Provincial Mobile Radio (PMR) Base Station Configuration		**Telecom**
	Wireless Cellular Connections for DG SCADA Applications		**Telecom**
DD-83-002	Application Guidelines for SEL 651R-1 Controller with 3 Phase G&W VIPER-ST 32-PIN Recloser	11/7/2014	P&C
LS-52000-001	Cable Insulation Liquids	11/3/2014	Lines
SS-65000-001	Technical Requirements for an RFP of Enclosure Assemblies	10/28/2014	Stations
PS-66100-002	Vendor Technical Requirements for the Supply of Terminal Blocks and Wiring Terminations	10/28/2014	P&C
DD-41-006	Installation Requirements for MUS rated up to 44kV outside a Station	10/6/2014	Stations
PD-66100-001	Standard labeling practices for PCT Equipment	9/24/2014	P&C
SS-10160-001	Technical Specification for Topographical Survey	8/15/2014	Stations
SD-57400-001	Design Guideline for Above Ground Control/Telecom/Station Service Cable Entrances into Substation Buildings	7/29/2014	Stations
SS-57400-001	Technical Specification for Cable Trays	7/22/2014	Stations
SS-54010-004	Performance Specification for 115 and 230kV Power Transformers	7/11/2014	Stations
ED-82200-001	Wood Pole Replacement Program Guidelines for Class EAs	7/11/2014	Environmental
DD-83-008	Application Guidelines for SEL 651R-1 Controller with 44kV 3 Phase Joslyn VBM Recloser	7/1/2014	P&C
LS-51000-001	Transmission faulted circuit indicators	6/25/2014	Lines
SS-65004-001	Technical Specification for PT and PT/CT Junction Box Assemblies	5/22/2014	Stations
SS-65508-001	Technical Specification for DC Station Service Distribution an Monitoring Enclosure Assemblies	5/22/2014	Stations
SS-65004-002	Technical Specification for CT Enclosure and Junction Box Assemblies	5/22/2014	Stations
PS-66450-001	SCADA Gateway (Real Time Data Concentrator and Protocol Translator)	5/9/2014	P&C

Standard #	Standard Type	Status	Published By (Group)	CSP#
LS-52043-001	Equipment and Material	Published	ENG-LINES	2014
PD-65104-002	Design	Published	ENG-EESNT	2014
SD-50000-001	Design	Published	ENG-STATION	2014
EP-82200-001	Functional	Published	ENG-ENVIRONMENTAL	2014
EP-83510-001	Functional	Published	ENG-ENVIRONMENTAL	2014
DD-83-005	Design	Published	ENG-EESNT	2014
	Design	**PENDING PUBLICATION 2016**	**TELECOM**	**CSP-1631**
	Design	**PENDING PUBLICATION 2016**	**TELECOM**	**CSP-1633**
DD-83-002	Design	Published	ENG-EESNT	2014
LS-52000-001	Equipment and Material	Published	ENG-LINES	2014
SS-65000-001	Equipment and Material	Published	ENG-STATION	2014
PS-66100-002	Equipment and Material	Published	ENG-EESNT	2014
DD-41-006	Design	Published	ENG-EESNT	2014
PD-66100-001	Design	Published	ENG-EESNT	2014
SS-10160-001	Equipment and Material	Published	ENG-STATION	2014
SD-57400-001	Design	Published	ENG-STATION	2014
SS-57400-001	Equipment and Material	Published	ENG-STATION	2014
SS-54010-004	Equipment and Material	Published	ENG-STATION	2014
ED-82200-001	Design	Published	ENG-ENVIRONMENTAL	2014
DD-83-008	Design	Published	ENG-EESNT	2014
LS-51000-001	Equipment and Material	Published	ENG-LINES	2014
SS-65004-001	Equipment and Material	Published	ENG-STATION	2014
SS-65508-001	Equipment and Material	Published	ENG-EESNT	2014
SS-65004-002	Equipment and Material	Published	ENG-STATION	2014
PS-66450-001	Equipment and Material	Published	ENG-EESNT	2014

Standard #	Standard Name	Last Published Date	Discipline
PD-66000-004	Design Guidelines for Layout of Protection, Control and Telecom Racks	4/24/2014	P&C
LS-20111-001	Supply of Wood Poles for use in Transmission and Distribution Lines	4/17/2014	Lines
SS-65102-001	550 kV High Voltage Air Disconnect Switches	4/4/2014	Stations
SS-65102-002	115kV and 230kV High Voltage Air Disconnect Switches	4/4/2014	Stations
SS-65102-003	38 kV and 48.3 kV Medium Air Voltage Disconnect Switches	4/4/2014	Stations
SS-54410-001	Transformers: Power, Sealed Tank Type Voltage Classification of 123kV and Less	2/20/2014	Stations
DD-83-006	Addendum to “Application Design Standard for SEL-351RS Controller with Single Phase G&W Viper-SP Recloser”	2/3/2014	P&C
DD-54-012	Neutral Conductor Down Lead Arrangement Options on DS Distribution Transformer	2/1/2014	Stations
PF-66450-006	**Decommissioning Procedure for Eaton SG 4250 Gateways (Hub / Station / Event)**		**P&C**

Standard #	Standard Type	Status	Published By (Group)	CSP#
PD-66000-004	Design	Published	ENG-EESNT	2014
LS-20111-001	Equipment and Material	Published	ENG-LINES	2014
SS-65102-001	Equipment and Material	Published	ENG-STATION	2014
SS-65102-002	Equipment and Material	Published	ENG-STATION	2014
SS-65102-003	Equipment and Material	Published	ENG-STATION	2014
SS-54410-001	Equipment and Material	Published	ENG-STATION	2014
DD-83-006	Design	Published	ENG-EESNT	2014
DD-54-012	Design	Published	ENG-EESNT	2014
PF-66450-006	**De-Commissioning**	**PENDING PUBLICATION 2016**	**ENG-EESNT**	**CSP-1699**

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #011

Reference:

Exhibit B1, Tab 1, Schedule 3

Interrogatory:

a) Page 20: Please provide the total number of delivery points for the years 2006 to 2016 and split between north and south.

b) Page 21: Please provide the most recent CEA reliability reports.

c) Pages 22 to 25: The Figures include the data values for Hydro One. Please provide the data values for the CEA Composite in Figures 8a, 8b, 9, 10, and 11 and add the CEA Composite data points for 2015.

Response:

a) The total number of Hydro One delivery points from 2006 to 2016 is provided in the following table. The 2016 number is based on the assumption that any current in service delivery point will be in service until the end of the year.

	Year										
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**End of June 2016**
North	150.5	150.0	150.6	149.2	147.5	146.4	146.7	148.6	149.2	148.6	148.0
South	713.4	720.5	730.3	733.0	738.3	742.4	745.6	751.0	752.4	750.2	751.8

b) The CEA "2014 Bulk Electricity System Delivery Point Interruptions & Significant Power Interruptions" report and "2014 Annual Report, Forced Outage Performance of Transmission Equipment" report are provided as attachments to this interrogatory. Both of these reports are to be treated as "CONFIDENTIAL".

c) The data values for the CEA Composite are provided in the following table. The CEA Composite data for 2015 will be available in the fourth quarter this year.

	Year									
Figure	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
8a	0.91	0.87	0.64	1.01	0.54	0.54	0.84	0.86	0.72	N/A
8b	0.79	0.74	0.75	0.71	0.64	0.69	0.90	0.83	0.83	N/A
9	1.70	1.61	1.39	1.72	1.18	1.23	1.74	1.69	1.55	N/A
10	91.3	68.3	62.0	56.2	50.4	80.8	66.7	96.2	74.9	N/A
11	24.4	18.8	21.5	25.0	13.3	23.4	14.0	27.1	19.2	N/A

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #011 (Attachment 1)

Hydro One has filed the Canadian Electricity Association's report entitled *2014 Bulk Electricity System Delivery Point Interruptions & Significant Power Interruptions* in confidence with the OEB. The 2014 annual report provides "All Canada" composite numbers for delivery point performance measures. Both the single year (2014) and five-year (2010 to 2014) average performance figures are provided in this report. This report is produced by the Transmission Consultative Committee on Outage Statistics (T-CCOS) with the CEA. Hydro One is a member of this committee. Please refer to Exhibit B1, Tab 1, Schedule 3, pages 19 to 22 for related information. The CEA 2014 composite numbers in Figures 8a, 8b, 9, 10, and 11 in that Exhibit are from this report.

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #011 (Attachment 2)

Hydro One has filed the Canadian Electricity Association's 2014 annual report entitled *Forced Outage Performance of Transmission Equipment* in confidence with the OEB. The 2014 annual report provides "All Canada" composite numbers for equipment performance measures. Only the five-year (2010 to 2014) average performance figures are provided. This report is produced by the Transmission Consultative Committee on Outage Statistics (T-CCOS) with the CEA. Hydro One is a member of this committee. Please refer to Exhibit B1, Tab 1, Schedule 3, pages 19 to 22 for related information. The CEA 2014 composite five-year moving averages in Figures 12 and 13 on page 26 of that Exhibit are based on information from this report.

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #012

Reference:

Exhibit B1, Tab 1, Schedule 3, Pages 26, Figure 12 and Figure 13

Interrogatory:

a) Please provide the CEA Composite 5 year moving average data value for 2015.

b) Please explain why the CEA Composite 5 year moving average is used over the CEA Composite.

c) Please provide Figure 12 and Figure 13 using the CEA composite for the years 2006 to 2015.

Response:

a) The most recent CEA report is for 2014. The CEA composite numbers won't be released for 2015 until the fourth quarter of 2016.

b) Please refer to the response in Exhibit I, Tab 01, Schedule 012, part a for the explanation of using five year rolling averages as the CEA composite.

c) Since the single year CEA composite numbers are not available, Figures 12 and 13 with annual CEA composite numbers is not available.

Witness: Mike Penstone

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #013

Reference:

Exhibit B1, Tab 1, Schedule 3, Page 26, Figure 12 and Figure 13

Interrogatory:

a) Please provide a Table that shows the number of forced outages for All Transmission Lines, and All Major transmission Station Equipment for the years 2006 to 2015.

b) Please provide a Table that shows the number of forced outages for the CEA Composite for All Transmission Lines and All Major Station Equipment for the years 2006 to 2015.

c) Figure 12: Please explain the spike in 2011.

d) Figure 13: Please explain the spikes in 2011, 2012 and 2014.

Response:

a)

Year	Number of Forced Outages	
	Transmission Line	Transmission Station Equipment
2006	213	469
2007	200	470
2008	173	447
2009	123	438
2010	110	410
2011	141	476
2012	147	403
2013	144	522
2014	75	490
2015	130	494

Witness: Mike Penstone

b) The CEA composite are five year rolling averages. The single year CEA Composite is not available. Therefore the annual number of forced outages for the CEA Composite from 2006 to 2015 is not available.

c) In 2011, two transmission line outages due to structures damaged by a tornado contributed to 49% of Annual Unavailability

Category	Equipment Type	Year	Cause	No. of Outages	Contribution to Annual Unavailability
Transmission Line	Transmission Line	2011	Defective Equipment - Structures damaged by tornado	2	49%

d) In 2011, eleven transmission station equipment outages caused by defective equipment contributed to 44% of Annual Unavailability

In 2012, eleven transmission station equipment outages caused by defective equipment contributed to 45% of Annual Unavailability

In 2014, ten transmission station equipment outages caused by defective equipment contributed to 39% of Annual Unavailability. One transmission station equipment outages caused by fire contributed to 3% of Annual Unavailability.

Category	Equipment Type	Year	Cause	No. of Outages	Contribution to Annual Unavailability
Transmission Station Equipment	Power Transformer	2011	Defective Equipment	5	26%
Transmission Station Equipment	Circuit Breaker	2011	Defective Equipment	6	18%
Transmission Station Equipment	Power Transformer	2012	Defective Equipment	3	12%
Transmission Station Equipment	Circuit Breaker	2012	Defective Equipment	7	27%
Transmission Station Equipment	Shunt Reactor	2012	Defective Equipment	1	6%

Category	Equipment Type	Year	Cause	No. of Outages	Contribution to Annual Unavailability
Transmission Station Equipment	Power Transformer	2014	Defective Equipment	1	3%
Transmission Station Equipment	Power Transformer	2014	Fire	1	3%
Transmission Station Equipment	Circuit Breaker	2014	Defective Equipment	7	29%
Transmission Station Equipment	Shunt Reactor	2014	Defective Equipment	2	7%

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Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #014

Reference:

Exhibit B1, Tab 1, Schedule 3, Page 28, Figure 14

Interrogatory:

a) Please provide a chart that shows the number of Delivery Points that are: outliers by Group Criteria only; outliers by both group and individual criteria; and outliers by individual criteria only for the years 2010 to 2014 and add 2015 data.

b) Please identify the delivery point performance outliers from Figure 14 that are included in investment programs in the current application and provide the cost.

c) Please explain the root cause of unreliability associated with each delivery point outlier in part (b).

Response:

a)

	2010	**2011**	**2012**	**2013**	**2014**
Outliers by Group Criteria only	88	78	68	71	61
Outliers by Both Group and Individual Criteria	13	19	9	13	18
Outliers by Individual Criteria Only	17	25	19	29	26

2015 data is not yet available.

b) and c) An individual list of delivery point performance outliers is not provided in order that customer sensitivity issues can be respected. However, as set out in the table above, the latest CDPP report for 2014 has 105 outliers. Many of these outliers are associated with capital investment plans in place over the submitted capital planning timeframe.

Hydro One has identified the majority of performance root causes to be at the transmission circuit level, due to equipment, weather or foreign (i.e. vegetation contact). The 105 outliers in the report represent 53 transmission circuits in total. Of these 53 supply circuits, 44 of these circuits have capital replacements programs / plans in place, spanning many different asset classes such as conductor refurbishment or replacement, insulator replacement, wood pole replacements, shield wire replacement, tower coating and foundations repairs, with

several circuits having more than one replacement program investment planned. These 44 circuits represent 91 of the 105 delivery point performance outliers. The costs for these investments are not compiled here as they span many investment programs and investments plans, can be subject to change based on monitoring of post-report performance (see below re: return to normal status) and program funding approval levels.

Within the analysis completed by Hydro One, a number of delivery point performance outliers were found to have achieved outlier status from either a singular sustained event that increases the duration of interruptions, or through a series of short-term (i.e. momentary) weather-related (i.e. lightning) events that increase the frequency of interruptions. In each case, an outlier status is triggered. In many cases, the performance of the delivery point outlier is witnessed to have returned to normal and within acceptable standard performance levels, which are monitored annually to ensure this occurs. In these cases it is not prudent to make remedial investments.

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #015

Reference:

Exhibit B1, Tab 1, Schedule 3

Interrogatory:

a) Please complete the following Table:

	2010	2011	2012	2013	2014	2015
Multi-Circuit Delivery Point: Total # of Forced Interruptions						
Multi-Circuit Delivery Point: Total # of Forced Interruptions due to equipment failure						
Single-Circuit Delivery Point: Total # of Planned Interruptions						
Single-Circuit Delivery Point: Total # of Planned Interruptions due to equipment failure						

Response:

Data requested is submitted in the table below, and explained here.

Row 1: For Multi-Circuit Delivery Points, this is the total number of Forced Interruptions/Year

Row 2: For Multi-Circuit Delivery Points, this is the subset of Forced Interruptions that were caused by equipment failure

Row 3: For Single-Circuit Delivery Points, this is the total number of Planned Interruptions/Year

Row 4: Interruptions caused by equipment failure, whether on Multi-Circuit or Single-Circuit supplies, would be included in a Forced Interruptions category, not Planned, therefore, there are none for this category.

Witness: Mike Penstone

		2010	2011	2012	2013	2014	2015
1	Multi-Circuit Delivery Point: Total # of Forced Interruptions			176	190	229	224
2	Multi-Circuit Delivery Point: Total # of Forced Interruptions due to equipment failure			53	51	39	83
3	Single-Circuit Delivery Point: Total # of Planned Interruptions			7	51	105	88
4	Single-Circuit Delivery Point: Total # of Planned Interruptions due to equipment failure			0	0	0	0

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #016

Reference:

Exhibit B1, Tab 2, Schedule 2, Page 2

Interrogatory:

Preamble: One of the new communication initiatives undertaken in 2015 involved the preparation and distribution of reliability reports specific to the delivery points that supply transmission customers. These reliability reports provide a history of delivery point performance, operating events and outcomes related to these delivery points, and sustainment plans that will impact these delivery points.

a) Please provide the total number of reliability reports issued to date and the number of Multi-circuit and Single-circuit delivery points impacted.

b) Please provide a copy of a reliability report related to a delivery point with a significant history of delivery point performance.

Response:

a) To date, a total of 133 Transmission Customer Reliability (TCR) Reports have been issued to Customers, covering 430 Delivery Points in total, of which 345 are Multi-circuit and the remaining 85 are Single-circuit. Based on the total number of current delivery points on the Hydro One transmission network (including DPs that supply Hydro One Distribution), TCR reports have been sent for 54% of Multi-circuit DPs and 33% for Single-circuit DPs.

b) A sample TCR report is found as Attachment 1 to this interrogatory, with real reliability data and information, but has been made generic to maintain Customer confidentiality.

TRANSMISSION CUSTOMER RELIABILITY REPORT

[Customer] - Q1 2015

This report provides a summary of your transmission connection, including delivery point performance, asset conditions, planned investments and maintenance relating to your operations.

2014 Operations Summary

Hydro One delivers electricity to your facilities through one or more delivery points.

Electricity is delivered to [Customer], at 1 delivery point. An interruption is a complete power disruption to your delivery point, and does not include power quality (voltage sag) events.

Delivery Point	Configuration	Voltage (kV)	10-yr Interruption Average	2013 Interruptions	2014 Interruptions
[Customer DP]	Single circuit	115 kV	5.3	13	8

No interruptions Less than 10-yr avg Exceeds 10-yr avg

Commentary

- Transmission delivery point performance improved from 2013 to 2014. Your delivery point was above its 10-yr average in 2013 and 2014.
- Hydro One provides customer briefings on request in response to significant events impacting your delivery point. 1 customer briefing was provided to [Customer Contact] in 2014:
    - [Customer Circuit] Switching Incident and Subsequent Outages, [Date]

Power Quality

- [Customer] is sensitive to power quality issues and is currently a participant in Hydro One's Power Quality Working Group

Tx System Demographics and Condition Snapshot

Asset condition is a weighted composite score based on demographics, condition, performance and economics used in Hydro One's Asset Analytics system.

The asset condition ratings for the stations and circuits that your reliability depends on:

Station or Circuit	Asset Condition Score[1]	Right-of-Way Vegetation Mgmt Score[2]
[Customer Circuit]	35	5*
[Station 1]	22	N/A
[Station 2]	18	
[Station 3]	25	
[Station 4]	28	

[1]Asset Condition Score:
Very good (1-15) Good (16-30) Fair (31-50) Poor (51-70) Very Poor (71-100)

[2]Vegetation Mgmt Score (based on number of years since last maintenance):
6 year maintenance cycle 8 year maintenance cycle

*In response to a vegetation related outage in 2014, targeted clearing was completed

Investment Outlook

Through our asset planning programs, the need for capital investments are identified, planned and prioritised.

The following investments have been previously completed in your area:

Station or circuit	Investment	Year
[Customer Circuit]	Replacement of 16 steel structures between [Jct]	2013
[Station 3]	Replacement of 2 power transformers	2013
[Station 2]	Replacement of 1 power transformer	2014
[Station 1]	Replacement of 230 kV capacitor bank	2014

These investments will be taking place from 2015 – 2018 to address assets in fair condition or below, or to address unique reliability issues. Capital projects are planned to bundle multiple asset replacements in one geographic area to minimize planned outages affecting your delivery point.

Station or circuit	Investment	Year
[Customer Circuit]	Shieldwire replacement along 4 line sections	2015
	Replacement of approximately 37 wood poles	2015
	Installation of approximately 48 surge arrestors along the [section]	2015
	Shieldwire replacement along 2 line sections	2016
[Station 4]	Station refurbishment- 2 power transformers, 3 breakers, capacitor bank, switches, surge arrestors, installation of a Protection, Control, & Telecom (PCT) building	2016
[Station 2]	Station refurbishment- 2 power transformers, 9 circuit breakers, installation of a PCT building, insulator replacement	2018

- Hydro One is currently in the process of studying the benefits of Surge Arrestor installation on [Customer Circuit]. The results of this study and subsequent action items will be presented to [Customer] in Q2, 2015

Upcoming Maintenance in Your Area

Maintenance is performed on all station and lines equipment on a regularly scheduled basis.

- Stations maintenance activities are unique to each type of equipment in our stations. These activities are planned and tracked in our work management system. All Station equipment maintenance in your area is up-to-date and on schedule for 2015.

- Lines maintenance planned for 2015:

Circuit	Maintenance activity description
[Customer Circuit]	Detailed helicopter inspection, thermovision inspection

- Vegetation management planned for your area:

Circuit	Year	Vegetation management activity description
[Customer Circuit Section 1]	2015	Condition patrol
	2019	Line clearing, brush control
[Customer Circuit Section 2]	2018	Condition patrol
	2022	Line clearing, brush control
[Customer Circuit Section 3]	2017	Line clearing, brush control
	2021	Condition patrol
[Customer Circuit Section 4]	2017	Line clearing, brush control
	2021	Condition patrol

2015 Planned Outages

Planned outage information is delivered on a weekly basis to [Customer Contact] at [Customer Facility] by our OGCC Operating Planning Department.

For further information:

Account Executive: John Blackburn
OGCC Customer & Operating Support contact: Keith Lascelles

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #017

Reference:

Exhibit B1, Tab 2, Schedule 2, Page 4

Interrogatory:

Preamble: Hydro One indicates it has a Power Quality Customer Working Group that is made up of Hydro One staff and industrial customers.

a) Please describe Hydro One's key challenges with respect to power quality.

b) Please provide the membership list and Terms of Reference for the Working Group.

c) Please confirm the start date of the Working Group.

d) Please discuss the progress to date on determining processes to identify, diagnose and measure power quality issues.

e) Please provide a summary of changes implemented by Hydro One as a result of the Working Group.

f) Please provide the meeting notes for the two power quality symposiums facilitated by Hydro One.

g) Please provide the key conclusions and recommendations from the two power quality symposiums facilitated by Hydro One.

h) Please provide a summary of changes implemented by Hydro One as a result of the symposiums.

i) Please provide the name of the internationally recognized power quality expert that assisted with the symposiums.

j) Please discuss Hydro One's process to notify customers of planned and unplanned loss of power and power quality issues.

Witness: Graham Henderson

k) Please discuss Hydro one's current and proposed power quality data collection capabilities.

l) Please provide Hydro One's current Power Quality metrics.

Response:

a) Key challenges in power quality ("PQ") faced by any utility in North America are due to the nature of a power quality event. See the definition of "power quality" in response (b) in Exhibit I, Tab 3, Schedule 25. The most common type of PQ event is voltage sag, which is a momentary voltage drop typically lasting less than 200 milliseconds.

A voltage sag PQ event depends on several factors:

- reliability or number of momentary interruptions (i.e. SAIFI) in circuits electrically close to the customer's supply point;
- system configuration and zone of influence, where the zone of influence is that part of the transmission system where a fault can cause a voltage sag event at the customer's supply point; and
- customer resilience. A potential PQ event may become a PQ event for some customers and not for others, depending on their degree of resilience.

The main challenge is that Hydro One can identify potential PQ events with simulations and its network of PQ monitors, but cannot predict or directly affect the degree of customer's resilience until a PQ event takes place and the customer is affected.

b) Attached are the members list, with names and email addresses redacted, and the terms of reference.

- Attachment 1 – Members List, Power Quality Customer Working Group
- Attachment 2 – Terms of Reference, Power Quality Customer Working Group

c) July 12, 2013 is the start date of the Working Group.

d) Over the last year, Hydro One has developed and implemented the following process to assess potential and actual PQ events:

- Hydro One measures potential PQ events with its PQ monitor network;
- Hydro One provides a voltage sag frequency, magnitude and duration report based on system performance averages to transmission-connected end-use customers; and
- Hydro One has initiated a pilot program to facilitate third party PQ audits to diagnose and improve the resilience of customers who are most sensitive to PQ issues.

e) The following list is a summary of undertakings resulting from the Power Quality Working Group:

- Published the "CEATI's PQ Reference Guide for Customers and Utility Representatives" document on the Hydro One website. (http://www.hydroone.com/IndustrialLDCs/Pages/PowerQualityProgram.aspx).
- Prepared and delivered voltage sag studies to estimate the frequency and duration of potential voltage sag events for transmission-connected industrial customers. This allows the customer to make informed decisions regarding potential resilience investments.
- Initiated the facilitation of third party PQ audits to allow customers to improve resilience at or beyond the guidelines in IEEE Std. P1668.
- Leveraged PQ-capable revenue meters to collect PQ data at the customer's site supply point. This is integrated with the main PQ data collection system.

To date, these have been relatively low cost initiatives. The cost of the initiative to leverage customer revenue meters as PQ meters is borne by Hydro One with some nominal costs to the customers. The cost of the pilot project to assess the value of third party PQ audits has been borne by Hydro One. The costing structure going forward has not been determined at this point in time.

f) There were no meeting notes from the PQ Symposium as the purpose of these symposiums was to provide information to customers from a recognized subject matter expert. Attached are the presentations provided at the PQ Symposiums.

- Attachment 3 – Power Quality Seminar, Hydro One 2014 Large Customer Conference, September 24, 2014
- Attachment 4 – Practical Power Quality Update and Case Studies – Hydro One 2015 Large Customer Conference, November 25, 2015

g) There were no key conclusions or recommendations for the reasons described in f) above.

h) No specific changes were implemented as the symposium was intended to be an informational session for customers.

i) The expert who assisted with the symposiums is Alex McEachern, President of Power Standards Lab.

j) Hydro One's processes to notify and engage customers regarding planned and unplanned loss of power and PQ issues are described below.

Planned Outage Notification

Overall Communication

- Transmission customers are notified by a weekly customer report (rolling 1 year window) which identifies all planned work that has the potential to impact the customer.

Long Term – 1 Year+ Out

- Customer conferences are held semi-annually to identify planned work for the coming year and discuss bundling opportunities with customer plant shutdowns or reductions.

Medium Term – 30 days

- Customer outages are identified in the weekly report.
- Customers are notified by email.

Short Term – < 30 Days

- Customer outages are identified by email.
- Customers are contacted by phone.

Real Time – Day of the outage

- The OGCC's control room interfaces with the customer(s) to coordinate the planned outage.

Note: All notifications are made per the contact list in the transmission connection agreement.

Unplanned Loss of Power

- OGCC's control room notifies the customer of the outage as per the transmission connection agreement.
- OGCC's control room follows the instructions described in the transmission connection agreement.

PQ Issues

- The transmission connection agreement lists contact information allowing the customer to contact the control room if the issue is "real time". The control room will look to mitigate the issue and/or refer customer to the relevant contact for further investigation.
- During a power disturbance that does not directly impact a large transmission-connected customer (i.e. loss of power), the OGCC's control room will contact customers that may have been affected from a PQ standpoint to notify, assess and understand impact of the event.
- For ongoing PQ issues or information regarding a previous PQ event, the identified contact for the customer to request information.

k) Hydro One has a growing network of 345 permanent PQ meters installed at a number of transmission stations. Hydro One plans to install 50 additional PQ monitors in the next five years. The number of revenue meters that can be used for PQ monitoring will increase depending on customer participation.

l) For PQ issues such as harmonics and flicker, Hydro One follows IEEE Std. 519 (*IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems*) and IEC 61000-2-2, respectively.
   - The power industry does not have PQ metrics for voltage sag events, which are the most common PQ issue, because they depend on factors such reliability, system configuration as well as customer resilience. Customer resilience is outside the control of a utility and is very customer specific.
   - Hydro One is actively participating in Electric Power Research Institute's efforts to closely follow the trends in different jurisdictions and the power industry in general. Electric Power Research Institute's distributive power quality study (DPQ III) showed that a facility connected to the transmission system (> 100 kV) is eight times more likely to receive a voltage sag than an interruption. This is consistent with Hydro One's experience.
   - From the point of view of resilience, Hydro One is promoting the acceptance of the guidelines in IEEE Std. P1668 among transmission- and distribution-connected large industrial customers.

Who's Who in the Power Quality Customer Working Group

Name	Email Address	Organization	Industry
[redacted]	[redacted]	Hydro One Networks Inc.	Electricity
		Hydro One Networks Inc.	Electricity
		Hydro One Networks Inc.	Electricity
		Hydro One Networks Inc.	Electricity
		Hydro One Networks Inc.	Electricity
		ArcelorMittal	Steel
		Domtar	Pulp and Paper
		General Motors Canada	Automotive
		Goldcorp (Musselwhite)	Mining
		Nova Chemicals	Petrochemical
		Xstrata Canada Corporation	Mining
		Shell Canada	Petrochemical
		Vale Canada	Mining
		Tembec	Pulp and Paper/Forestry

TERMS OF REFERENCE DOCUMENT

POWER QUALITY CUSTOMER WORKING GROUP

Table of contents

INTRODUCTION

PURPOSE

The Power Quality Customer Working Group will be collaboration between Hydro One and its customers to understand the customer experience related to power quality events. The goal is to better understand what customers are experiencing and the impacts to plant and production. The group will look at events that result in loss of power or power quality degradation that leads to losses in plant and affects production. Impacts to equipment due to power quality events will also be reviewed. The working group is not tasked to develop standards or provide solutions to power quality events, but to act in an advisory capacity to bring the customer issues to the forefront when seeking resolution by the entities that supply services to the customer.

BACKGROUND

Power quality events have been with us in the utitlity industry since inception and will continue to be due to the nature of the service and the physics that drive it. It is clear however that recently our power system has undergone significant changes. Some of these include renewable generation initiatives and conservation and demand management programs. The penetration of new high speed (solid state) technologies has increased dramatically in the past few years as well. As such, more and more customers are identifying power quality related events. AMPCO and the Ontario Mining Association have brought this issue forward in 2012 as one of the significant business impacts to large process based industry in Ontario. As a result, Hydro One and its customers have undertaken the Power Quality Customer Working Group to begin looking at what opportunities exist to limit the impacts.

CUSTOMER (SERVICE USER) IMPACT

In its advisory role, this working group is expected to bring the customers perspective to any solutions being sought to mitigate the effects of power quality events.

OPERATIONAL IMPACT

Hydro One's power quality steering committee and technical support teams will review the outcomes of the Power Quality Customer Working Group and take into consideration these outcomes when proposing solutions to power quality events.

OBJECTIVES /OUTCOMES

The objectives/outcomes of the working group will be as follows;

- *Define the impacts to the customer business when power quality related events occur.*
- *Review the findings/suggestions of the Hydro One power quality team to determine alignment with the customer needs.*
- *Discuss and agree on mutually acceptable definition of power quality.*
- *Identify opportunities for improved capture, recording and reporting power quality events.*
- *Agree on a methodology for power quality event measurement.*
- *Agree on a methodology and process for investigating power quality events.*
- *Classify the known types of power quality events experienced.*
- *Collectively propose potential solutions to each defined type of power qaulity event.*
- *Agree on the necessary additional participants to help in solution development for reducing power quality events.*
- *Agree on the necessary stakeholders that are not participants in the working group to help in solution development for reducing power quality events.*

- *Support efforts to implement any necessary changes to design, industry standards, operational procedures or other identified outcome requiring external participation.*
- *Reach consensus on guidelines that can help address power quality issues[added at PQ kick off – Adel]*

SCOPE

The Power Quality Customer Working Group has been established to bring the customers perspective to the treatment and management of power quality events.

In Scope

The following is considered in scope for the Power Quality Customer Working Group:

- *Procedures and processes related to identifying, monitoring, recording, and reporting on power quality events.*
- *System operating parameters.*
- *Materials developed by organizations/associations working on power quality.*
- *Identification of equipment susceptible to power quality events and their manufacturers.*
- *Compliance with Regulatory entities (NERC,NPCC,OEB)*
- *Reliability measurements*

SUCCESS CRITERIA

An understanding and agreement on what constitutes a power quality event, including a definition to support it being documented.

A methodology for identifying, reporting, recording, and correcting power quality events is developed and documented.

A revised power quality event reporting process based on customer input.

Development of a proactive approach to mitigate the potential for power quality events.

KEY ROLES

Role	Name	Organization
Facilitator	Brad Colden	Hydro One
Hydro One Power Quality Lead	Ian Bradley	Hydro One
Prime Contact for Hydro One PQ Team	Paul Malozewski	Hydro One.


Hydro One
2014 Large Customer Conference

Power Quality Seminar

Alex McEachern, Power Standards Lab
Alex@PowerStandards.com
September 24, 2014

hydro one

Alex McEachern

- President of Power Standards Lab (U.S.)
- 40 years of experience in 25 countries solving power quality problems
- Fellow, IEEE for contributions to power quality measurements
- Chairman of IEC Standard on power quality measurement methods
- Chairman, SEMI F47 standard on voltage sag immunity
- Awarded 31 patents (so far) in power quality

PSL Power Sensors Ltd

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Agenda

I. Practical power quality – a brief hands-on introduction
II. Voltage sags / dips
III. Harmonics
IV. Earthing and Grounding in plant
V. Practical electric power
VI. Power quality standards
VII. Power quality measurement and monitoring
VIII. Future power quality – what's coming

PRACTICAL POWER QUALITY – BRIEF HANDS-ON INTRODUCTION

Alex McEachern
Alex@PowerStandards.com

IS THE TRUCK TOO WIDE?
OR IS THE ROAD TOO NARROW?

 5

WAS THE POTHOLE TOO DEEP?
OR WAS THE CAR NOT BUILT STRONGLY ENOUGH?

 6

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Alex@PowerStandards.com

IT'S A <u>COMPATIBILITY</u> QUESTION.
(AND THE SAME IS TRUE
FOR POWER QUALITY.)

 7

OF COURSE, AT THE EXTREME, THERE ARE LIMITS ON WHICH WE ALL CAN AGREE…

 8

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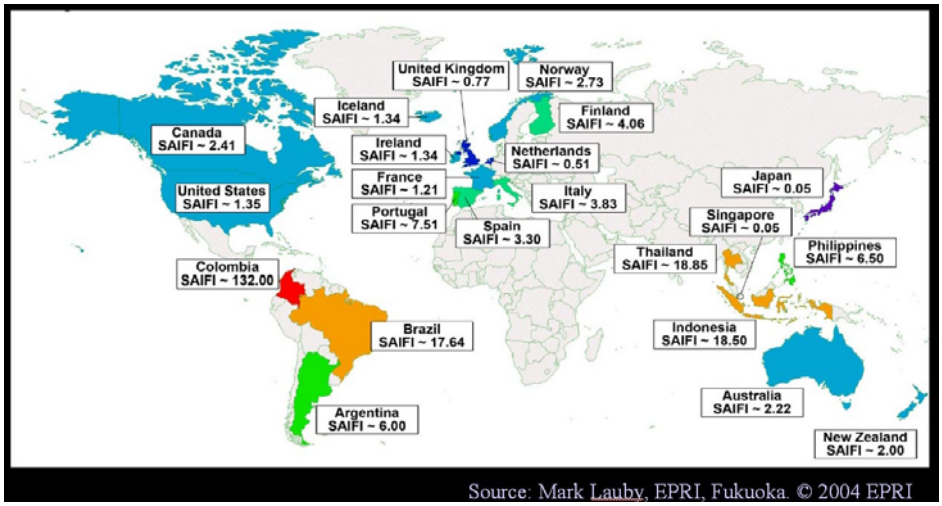
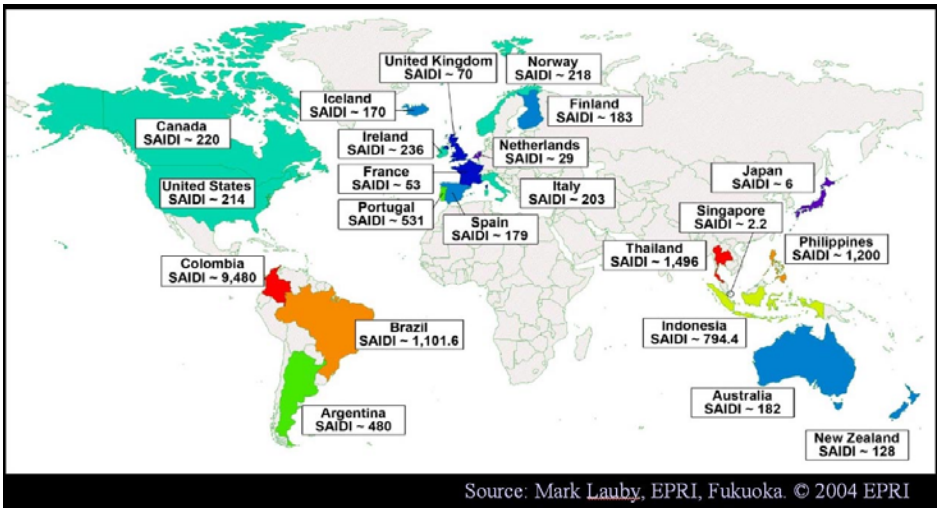
Alex@PowerStandards.com

Power quality world-wide



Power quality world-wide



Alex McEachern
Alex@PowerStandards.com

Practical power quality: a brief hands-on introduction

- Voltage sags and swells – real-world examples
- High frequency impulses – real-world examples
- Harmonic voltages and currents – real-world examples
- Earth / ground problems – in plant real-world examples
- Voltage Flicker
- 2kHz-150kHz emissions
- Problems that were incorrectly blamed on power quality

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Power quality around the world…

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Alex McEachern
Alex@PowerStandards.com

Power quality around the world…

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Power quality around the world…

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Power quality around the world…

(It's not so bad here, right? Actually pretty good!)

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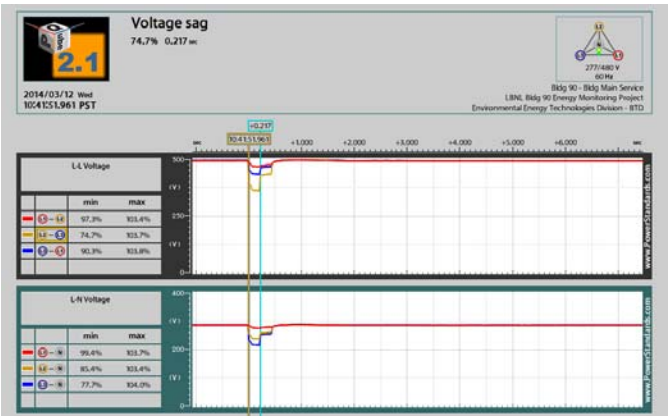
Voltage sags and swells – real-world example



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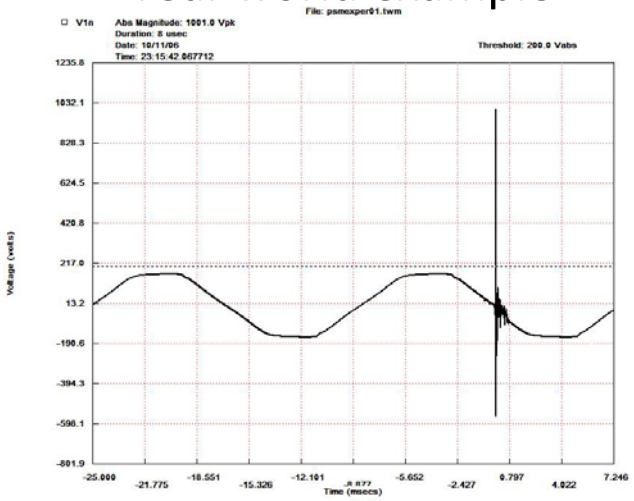
Alex McEachern
Alex@PowerStandards.com

Voltage sags and swells: real-world example

High frequency impulses: real-world example



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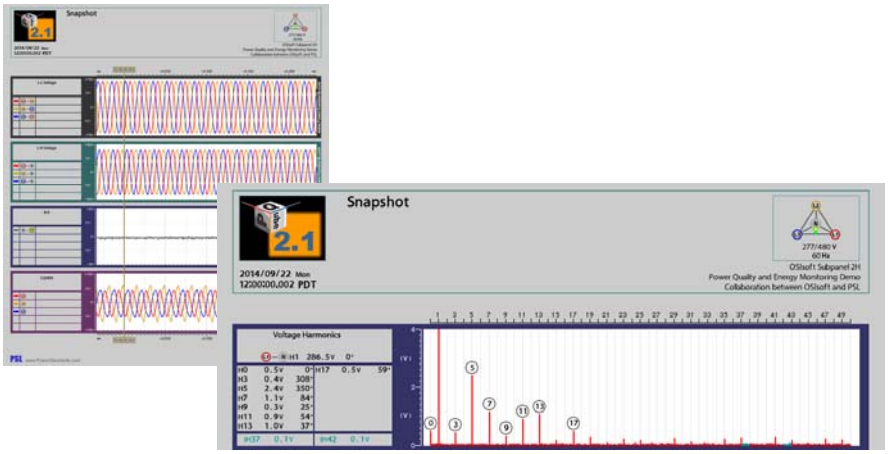
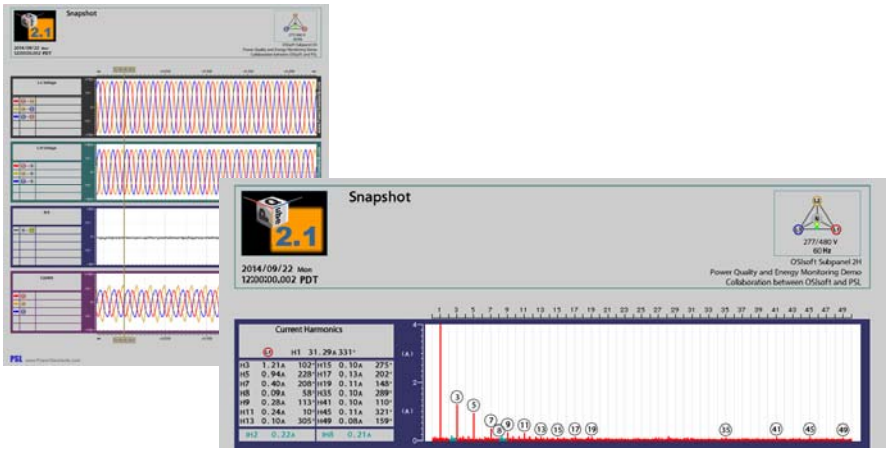
Alex@PowerStandards.com

Harmonic <u>voltages</u> and currents – real-world example



Harmonic voltages and <u>currents</u> – real-world example



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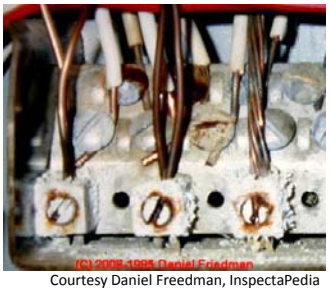
Earth / ground problems – in plant - real-world examples



Courtesy Daniel Freedman, InspectaPedia

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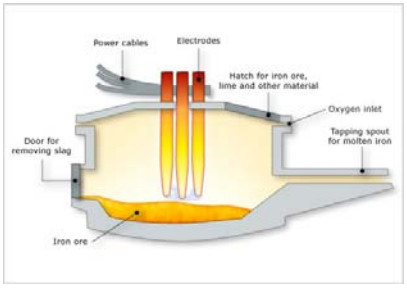
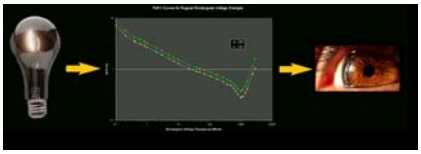
Voltage flicker





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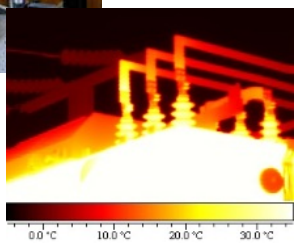
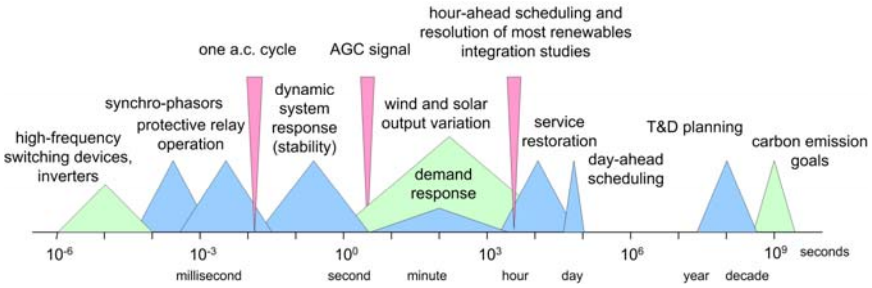
Problems that were incorrectly blamed on power quality…



Power quality & energy developments…

- Time scales of utility concerns



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Power quality & energy developments…

- Example: distributed photovoltaic power in Lanai

Seems like a good idea…

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Power quality & energy developments…

- Example: distributed photovoltaic power in Lanai

2kHz-150kHz…

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Power quality & energy developments…

- Example: distributed photovoltaic power in Lanai

What happens?

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Power quality & energy developments…

- Example: distributed photovoltaic power in Lanai

Lead-acid storage…

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Alex McEachern
Alex@PowerStandards.com

Power quality & energy developments…

- Conclusion: It's more complicated than it seems.

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VOLTAGE SAGS / DIPS – THE DETAILS

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Voltage sags / dips

a) Why sags and dips happen – the practical explanation
b) Why it is impossible for electric power companies to fix the problem
c) Brief discussion: impedances on the power grid
d) Typical characteristics of sags and dips
e) How to fix the voltage sag problem
   - Figure out exactly what the "problem" is
   - Sag correction devices
   - 'Increased immunity' solutions
   - How to use a voltage sag generator

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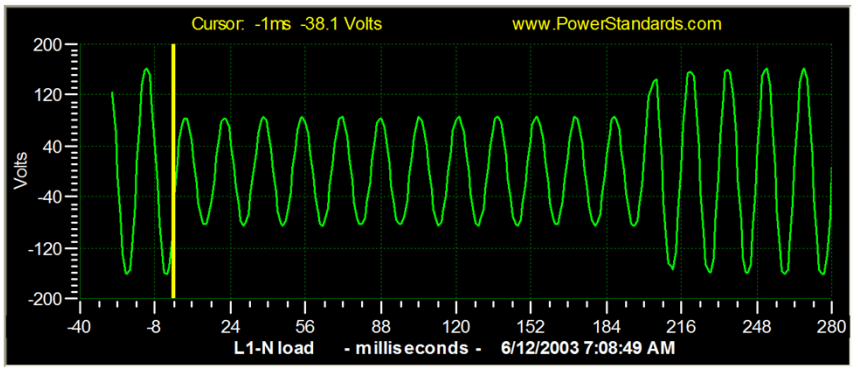
Voltage sags are the most common power quality problem.



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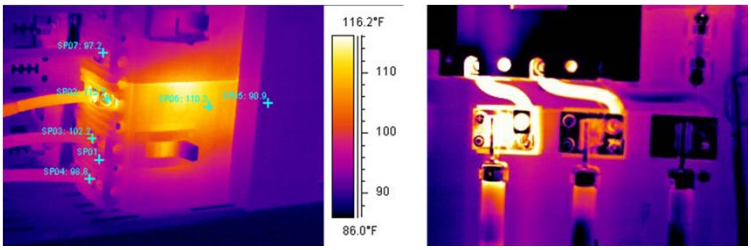
Why sags and dips happen

- Either increase in source impedance (rare)
- Or increase in current (common)



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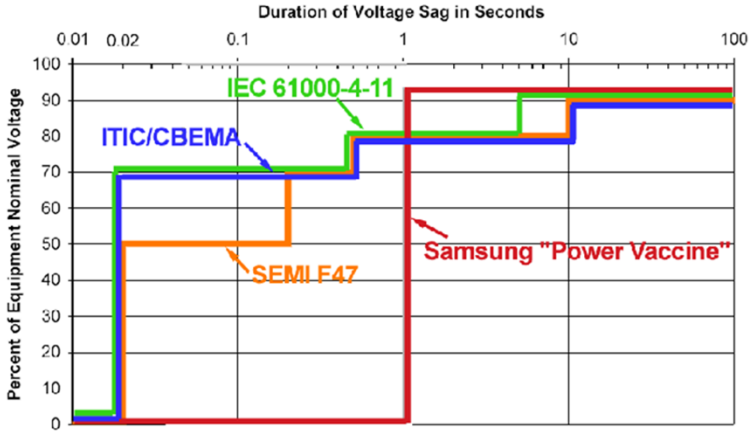
How to explain sags – non-technical

 34

Alex McEachern
Alex@PowerStandards.com

The standard way to describe a voltage sag



Why are these so similar?

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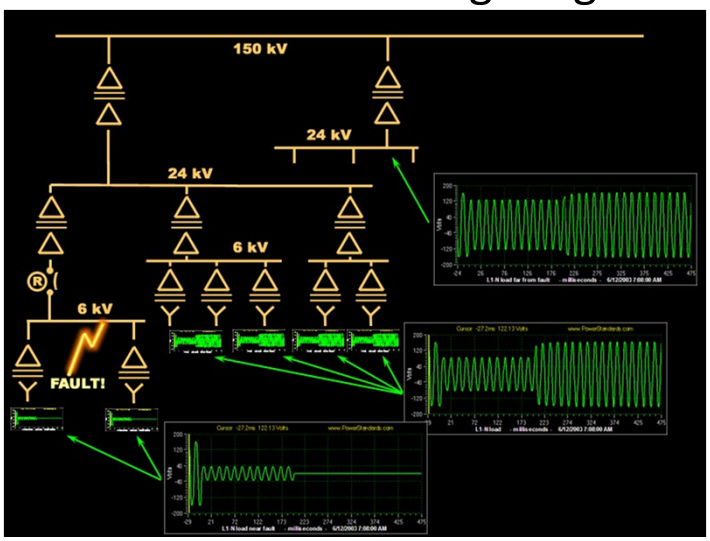
What causes voltage sags



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And what causes “faults”…




 37

And what causes “faults”…



 38

And what causes “faults”…

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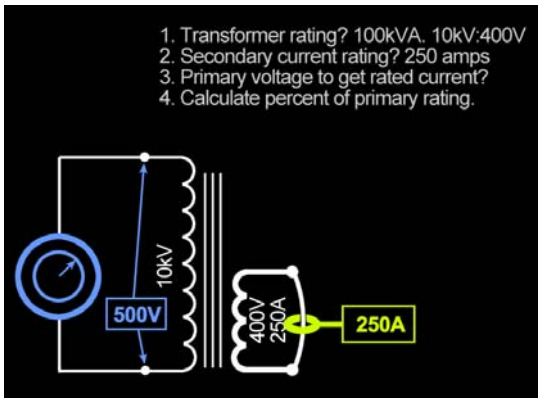
A comment on source impedance and circuit breaker safety

- How transformer impedance is measured, and what it means.



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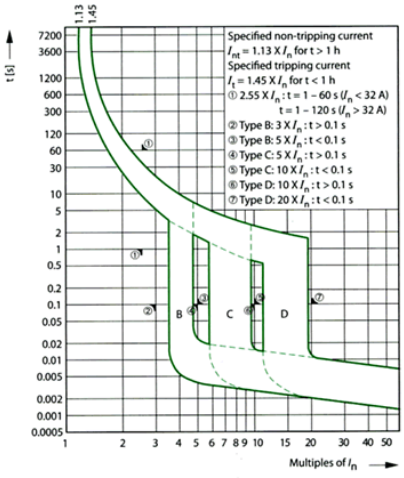
A comment on source impedance and circuit breaker safety



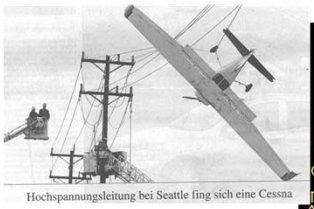
1% impedance – low distortion, fast trip, but dangerous AIC

5% impedance – safe AIC, but slow trip, distortion

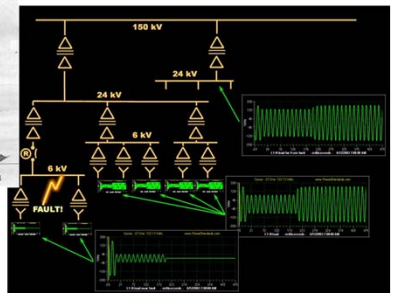
10% impedance – safe AIC, very slow trip, big voltage distortion

 41

And what causes “faults”…



Hochspannungsleitung bei Seattle fing sich eine Cessna



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Alex@PowerStandards.com

Why does lightning cause sags?

Physics.

Rules of thumb

- Distant – voltage sag
- Medium – brief interruption
- Very near – high freq impulse

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Why it is impossible for electric power companies to fix the problem

- How do you get rid of lightning, traffic accidents, animals, airplanes, backhoes...?
- So: what is the solution for voltage sags?

<u>Equipment compatibility.</u>

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Alex McEachern
Alex@PowerStandards.com

What if cars were engineered like this?

Note: requires road that is +/-10% smooth. Otherwise, wheels may fall off.

Aftermarket road-smoothers are readily available.

The voltage sag immunity solution – simple and cheap, usually.

- Equipment must <u>tolerate</u> certain voltage dips.
- For three-phase equipment, dip one phase, or one pair of phases, at a time. (Not three-phase dip).
- 80% for 1 second
- 70% of 0,5 second
- 50% for 0,2 second
- (40% for 0,2 second)
- 80% for 10 seconds
- IEC 61000-4-34
- SEMI F47)

PSL Industrial Power Corruptor
http://www.PowerStandards.com/SagGen.htm

Alex McEachern
Alex@PowerStandards.com

An alternate voltage sag solution – use inexpensive Power Quality relays.

- Makes intelligent equipment aware of power quality disturbances
- Converts the voltage sag problem from an energy problem into a much-easier-to-solve software/PLC problem
- Ideal for reset-tolerant processes.

https://powerstandards.com/PQ1.php

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Summary: Voltage sags: the most common problem

1. Caused by short circuits on the grid
2. Not reasonable to expect utility to eliminate
3. Best fixed with "equipment immunity" approach

- An important question: Is it <u>worth</u> fixing? What are the economic trade-offs?

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Alex McEachern
Alex@PowerStandards.com

HARMONICS

Harmonics

a) Practical introduction to harmonic concepts
b) Causes of harmonic currents and harmonic voltages
c) Effects of harmonic currents
d) Effects of harmonic voltages
e) Practical solutions to harmonic problems
   - Reducing impedance
   - Eliminating resonances
   - Harmonic filters – active and passive

Alex McEachern
Alex@PowerStandards.com

Practical introduction to harmonic concepts

Lights, heaters, motors

Short-cuts

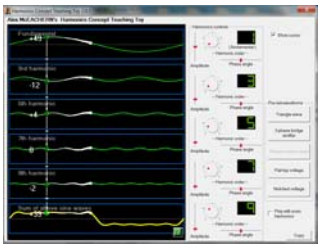
Sine wave = no harmonics
Not a sine wave = harmonics

Rules of thumb

Voltage harmonics:
~ a few percent
Current harmonics:
5% ~ 50%

Free download:

Power Quality Teaching Toy



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Causes of harmonic currents

- Power electronic devices: either “on” or “off”
  - Sources of harmonic currents in process equipment
  - Single-phase supplies (the “peak”)
  - Three-phase supplies (the “camel”)
  - Phase-controlled loads
  - Arcs
- Introduction to harmonic propagation in the power system
  - Third harmonic in neutral conductors
  - Effect of transformers

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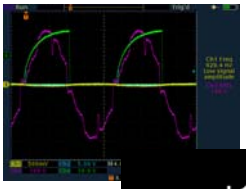
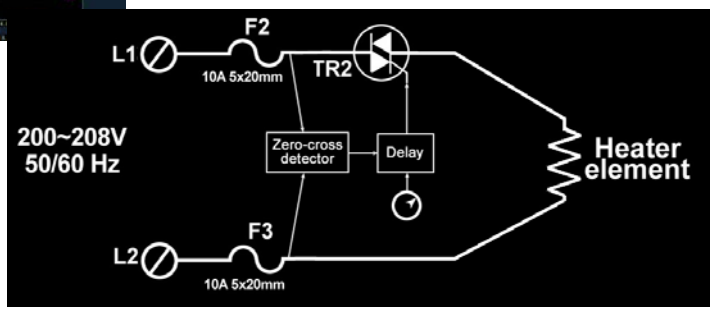
Causes of harmonic currents

Current waveform Voltage waveform





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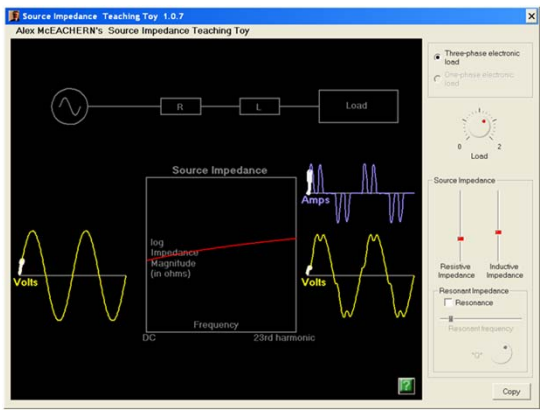
Cause of harmonic voltages: impedance

- "Normal" case
- Resonance



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Effects of harmonic currents

- Overheated transformers
- Overheated neutral conductors
- Poor power factor (lots of current, for not much power)
- Interference

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Effects of harmonic voltages

- Complaints…
- Harmonic currents in traditional loads (?)
- Metering problems
- Unexpected trips: Ground Fault Interruptors

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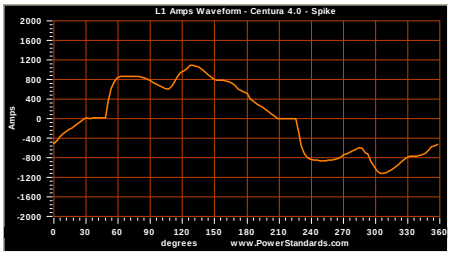
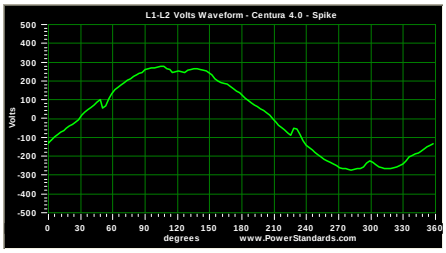
Effects of harmonic voltages

- Problem with source – too much distorted current?
- Problem with the load – too sensitive?
- Problem with the distribution system – impedance, resonance? **Answer: whatever is easiest to fix.**





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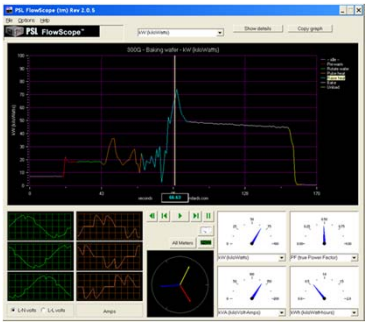
Cheap Simple Solutions to Harmonic Problems

(First, is it a problem?)



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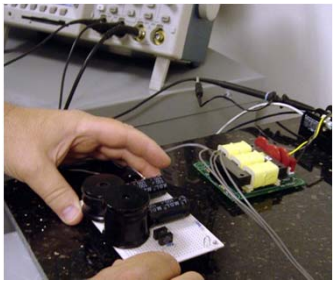
Typical Low-Cost Circuit Modifications

- RC or LC filters on signals
- Simplified trigger circuits
- Move sensitive load to non-disturbed source
- Reduce sensitivity of peak detectors



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Harmonic Filters

- General categories and costs of filters
  - Active vs. passive
- Typical installation and application problems
  - Ratings
  - Attraction of other harmonic sources
  - Reliability
  - Economic returns – practical indication

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Summary: Practical solutions to harmonic problems

- Rarely a utility problem – almost always inside the building
- Reducing impedance
- Eliminating resonances
- Harmonic filters – active and passive

- Important question: do you need to solve the problem? What are the economic trade-offs?

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LUNCH – 12:00 – 1:00 PM

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PRACTICAL ELECTRIC POWER

Practical electric power

a) Distribution system practices
b) Available voltages, and phasing variations
c) Color-coding and grounding practices
d) Grounding problems, wiring problems in plants

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EARTHING AND GROUNDING IN PLANT

Ground / protective earth

- Three purposes
  - Safety
  - Signal return path
  - Radiation – emission, susceptibility
- <u>All three are in conflict!</u>

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Ground / protective earth

- Problem with “Connect it to ground”
  - What ground? Where?
- Ground current, and voltage differences
- Earth currents – 10-2A ~ 105A
- Earth impedances
  - Resistive for sheets, solids
  - Inductive for lines
  - Radio frequencies – anything longer than 0,1 wavelength

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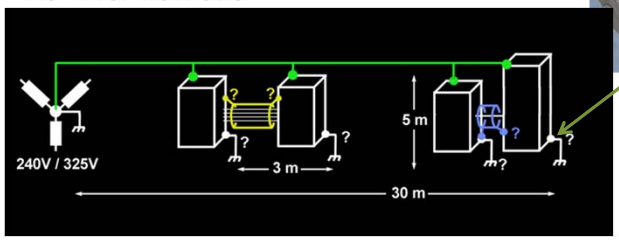
Ground / protective earth

- Example of ground voltage differences
- How much voltage makes a difference?
  - 10^{-3}V for analog signals
  - 10^{0}V for digital signals
  - 10^{1}V for humans



The grounding problem

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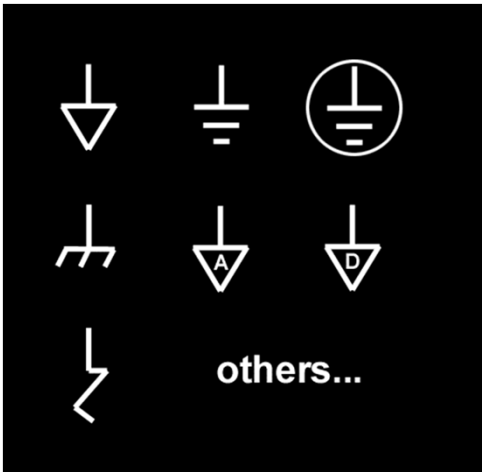
Ground / protective earth – symbols and names

- Chassis ground
- Ground
- Ground reference
- Shield
- Ground bus
- Earth
- Protective Earth
- PE
- Others…



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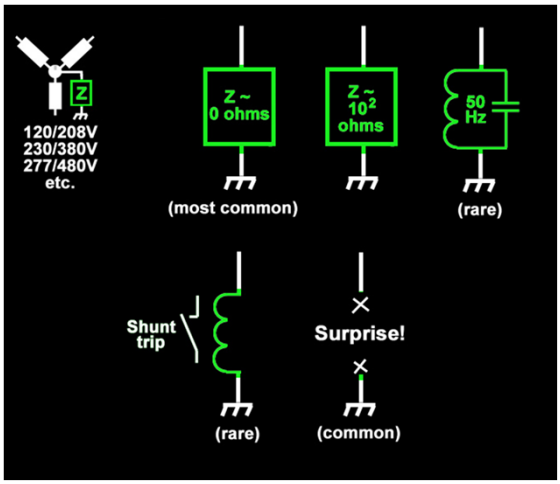
Ground - world-wide practices



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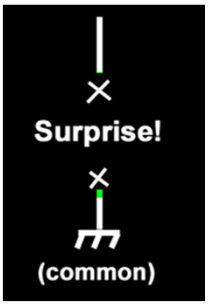
Ground - world-wide practices



Examples
- Corrosion
- British factory
- China factory
- Plating

Ground - world-wide practices

- Grounds at factories
- Constant changes to ground paths
- New “hammered” grounds
- Changes in building steel
  - Construction
  - Accidents (tilt-up, steel frame)
- Re-wiring by local electricians
  - “Local” practices
  - “Building owner” practices
  - “Equipment” practices
  - Example: French-owned factory in South Africa with Japanese equipment…

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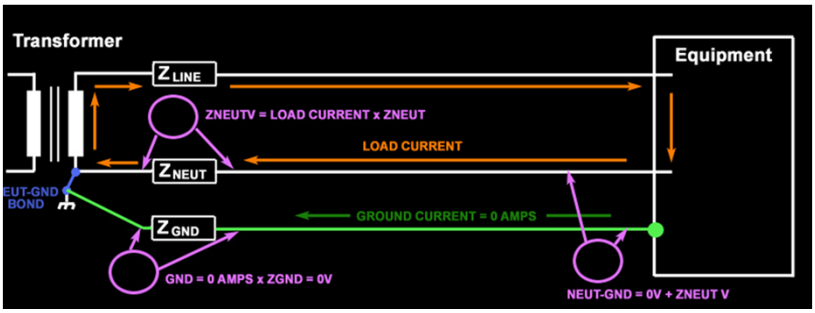
Neutral vs. Ground. Neutral-Ground voltages

- Neutral is a current-carrying conductor
- Ground is not (except in emergencies)



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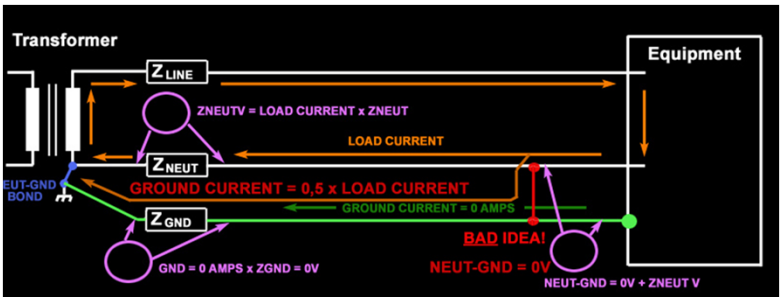
Neutral-Ground mistakes

- Giving “Neutral” and “Ground” the same name
- Connecting Neutral and Ground (except at transformer)



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Neutral-Ground mistakes

- Giving “Neutral” and “Ground” the same name
- Connecting Neutral and Ground (except at transformer)

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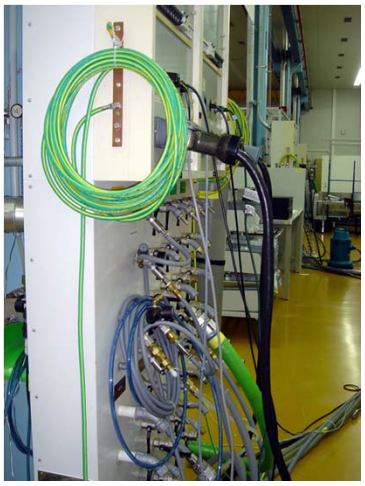
Ground “noise”



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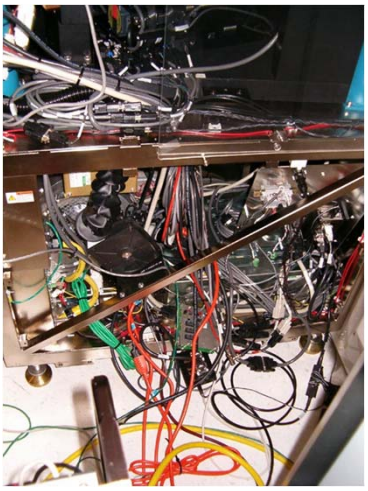
Ground "noise"

- "Noise on the ground" – relative to what?
- Oscilloscope probe – relative to scope shield / ground
- Every voltage is *between* two different physical points.
  - "Ground" is not ground.
  - Ground currents, and ground impedances, cause voltage drops between different grounds.



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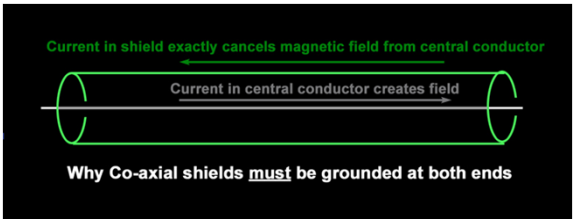
Ground / Protective Earth in factory equipment

1. Connect cabinets to Protective Earth.
2. Connect one end of cable shields to ground.
   - What does this mean for extension cables?
3. Connect both ends of coax shield to ground.
4. Use local Radio Frequency grounds.
5. If possible, isolated all control signals from ground.



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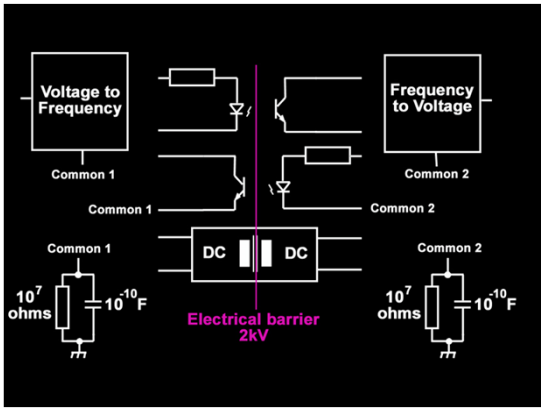
Ground / Protective Earth in factory equipment

- Isolating all control signals from ground:



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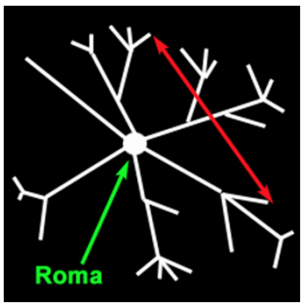
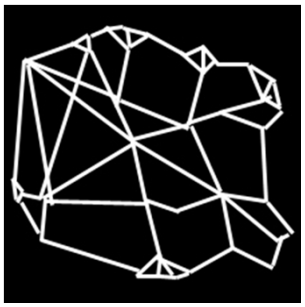
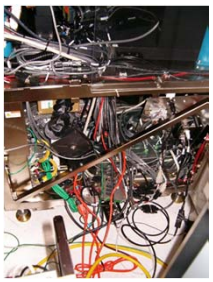
Grounding arrangements

Star	Mesh	Careless
Optimized for analysis Difficult to maintain	Optimized for impedance Difficult to analyze	Not optimized







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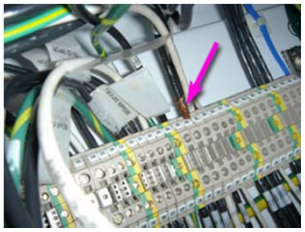
Practical grounding problems

- Unexpected insulators
  - Clear finishes on metal surfaces
  - Corrosion
  - Loose connections – crimps, fasteners, fine strands
- Inductors
  - Coiled ground wires
  - Long ground runs
- Loops
  - Building loops
  - Shields grounded at both ends



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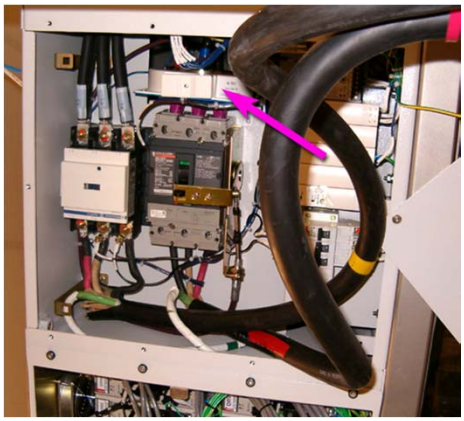
Ground leakage relays



Big problem: noise filters with capacitors to ground

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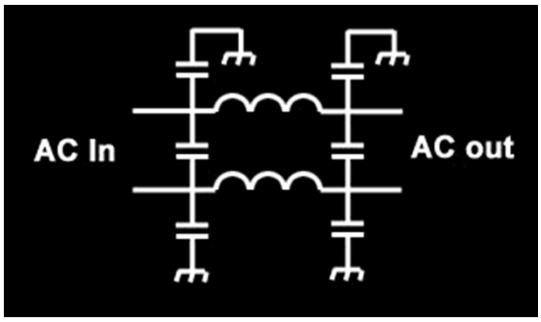
Ground leakage sources

Capacitor current:

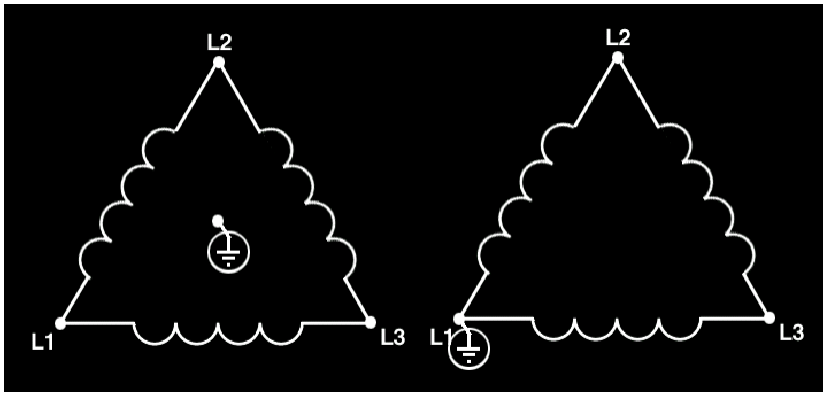
$I = E \times 2\pi f \times C$



Problems:

1. Number of filters – one on every component in system
2. Voltage – unexpected line-to-ground voltages in Japan
3. Frequency – what about voltage harmonics?

Ground leakage source – Japanese grounding



North America
200V phase-to-phase,
115V phase-to-ground

Japan
200V phase-to-phase,
200V phase-to-ground

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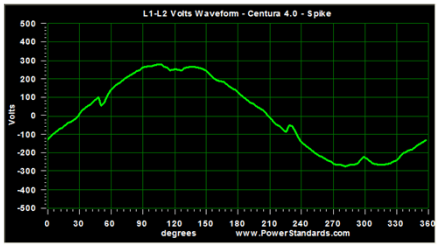
Ground leakage source – Voltage harmonics

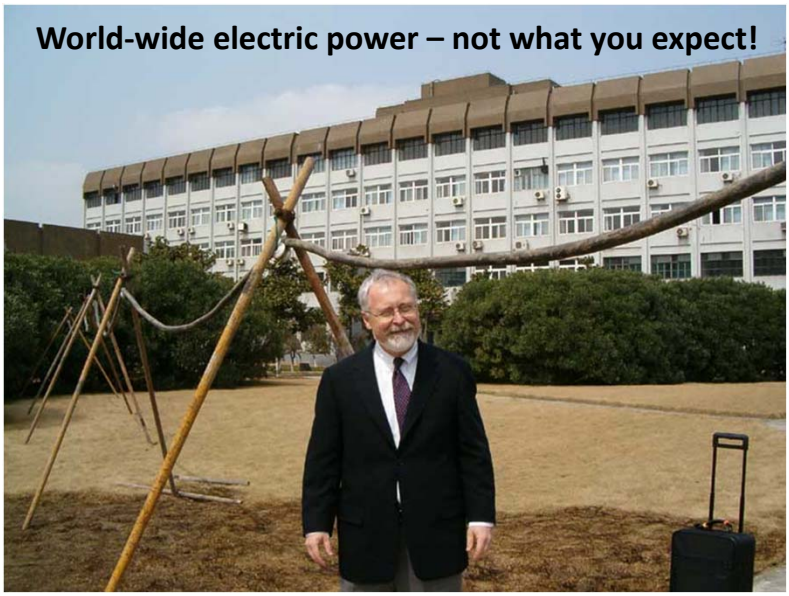


Capacitor current:

$I = E \times 2\pi f \times C$

	RMS volts	sine angle		RMS volts	sine angle
Fund	191.1 Vrms	-30°	2nd	1.2 Vrms	-50°
3rd	3.9 Vrms	162°	4th	0.9 Vrms	-97°
5th	8.0 Vrms	16°	6th	0.4 Vrms	
7th	5.7 Vrms	168°	8th	0.7 Vrms	144°
9th	3.1 Vrms	-170°	10th	0.8 Vrms	-155°
11th	5.3 Vrms	-3°	12th	0.5 Vrms	18°
13th	2.8 Vrms	-77°	14th	0.5 Vrms	140°
15th	2.5 Vrms	-174°	16th	0.9 Vrms	-119°

World-wide electric power – not what you expect!



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World-wide terminology and labels

Conductor Designation	Comments
L1-L2-L3	Universally understood
A-B-C	
R-S-T	In some countries, an "old-fashioned" designation but still understood.
U-V-W	May indicate the secondary of a transformer (e.g. Japan) or may indicate current (e.g. Austria)
X-Y-Z	Fairly common in North America
0-4-8 or **8-0-4 or 12-4-8**	Indicates phase angle corresponding to hours on an analog clock (Spain, Italy)
Red-Yellow-Blue	Common designation outside North America; sometimes abbreviated with the first letters of the local language
Brown-Black-Purple, Red-White-Blue, Yellow-Green-Violet, etc.	Standard local color codes (South Africa, Austria, etc.) Each country may have its own color convention, so it can be dangerous to rely on color to indicate phase.

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Voltages and frequencies worldwide

Nominal voltage	Comments
100V	Generally Japan only
110 / 115 / 117/ 120V	Common single-phase voltages; older equipment and systems may be designated with the lower voltages.
200V	Generally Japan only – may be single-phase, or phase-to-phase on a 3-phase system
208V	Phase-to-phase voltage on a 120/208 3-phase system
220 / 230 / 240V	Common single-phase voltages and three-phase voltages. Older equipment and systems may be designated with the lower voltages. Generally, Southern and Eastern Europe still use 220V, while most of western and central Europe use 230. Great Britain uses 240, but is moving towards 230. Common residential split single-phase in North America.
277V	Phase-to-neutral voltage on a 3-phase 480V phase-to-phase system. Commonly used in North America for single-phase fluorescent lamps
380 / 400 / 415V	Phase-to-phase voltage on a system with 220/230/240V from phase to neutral
480V	Common North American industrial voltage – can be single-phase, but more often phase-to-phase on a 3-phase system
600V	Generally Canada only – industrial 3-phase
693V	Not common, but occasionally found in 50 Hz industrial regions. 3-phase system with 400V from phase to neutral.

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Voltages and frequencies worldwide

- Exactly 50,000 Hz or 60,000 Hz
- Or maybe not…
  - UPS ± 0,5 Hz
  - Diesel generator ± 5,0 Hz
  - Both are common at semiconductor fabs

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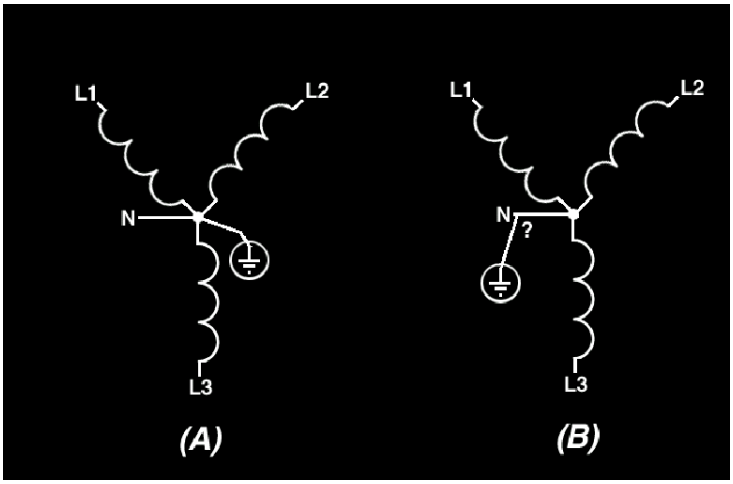
Phase, neutral, ground worldwide



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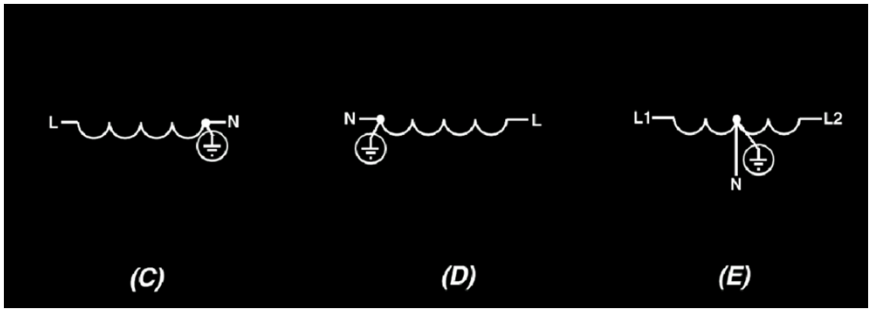
Phase, neutral, ground worldwide



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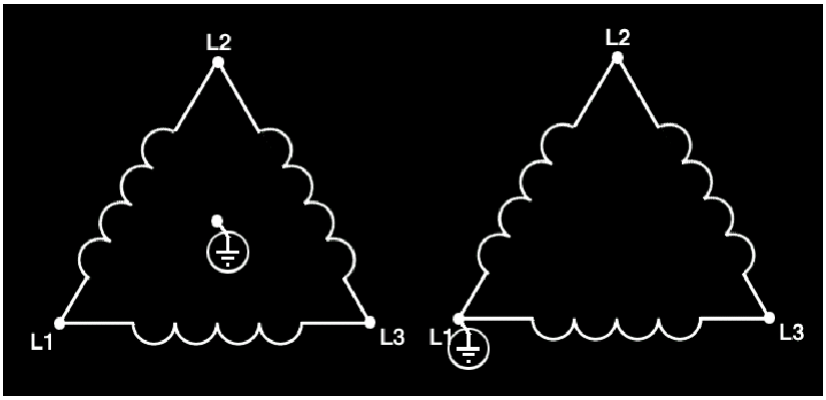
Phase, neutral, ground worldwide



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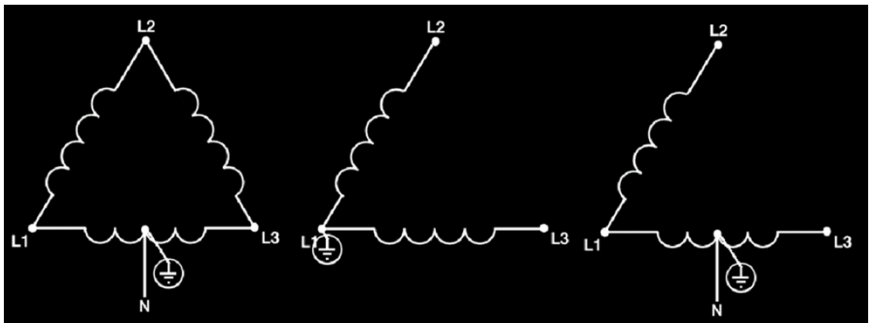
Phase, neutral, ground worldwide



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Phase, neutral, ground worldwide

- Never specify 230V 3-phase power!
  - In some parts of the world, means 230/400V
  - In some parts of the world, means 230 phase-to-phase

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Electrician attitudes – world-wide

1. Local way of doing things is correct.
2. Every other way is wrong, and needs to be re-wired.
3. Why does not matter.

Even experts are sometimes wrong…

This can lead to exciting discussions at Singapore factories, with German electricians, installing Japanese equipment.

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POWER QUALITY STANDARDS

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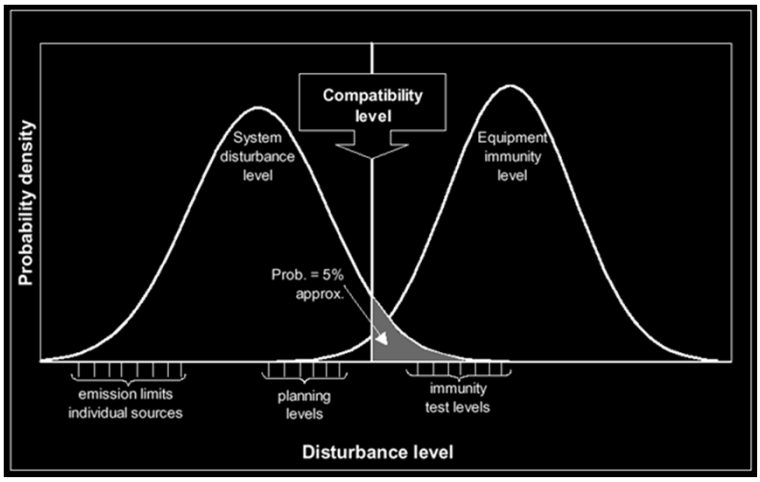
Power quality standards

a) Immunity-based standards – the basic idea of compatibility

b) Voltage dip/sag immunity – SEMI F47, IEC 61000-4-11, IEC 61000-4-34, CBEMA, ITIC

- Which standard should you use?
- Unbalanced vs. balanced sags on 3-phase systems
- Pass-fail criteria – some practical problems
- Planned revisions to these standards

Immunity-based standards – the basic idea of compatibility



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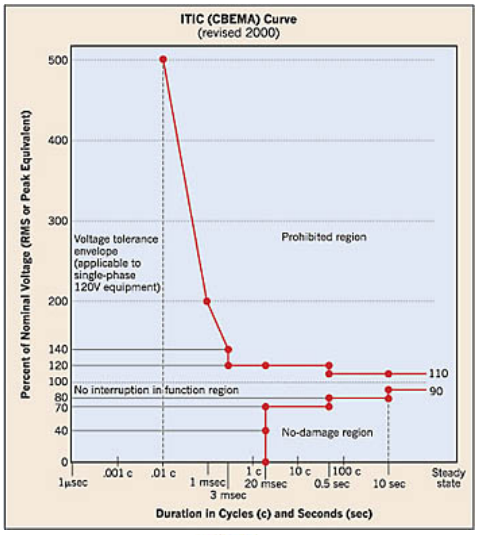
Immunity-based standards



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Voltage dip/sag immunity – SEMI F47, IEC 61000-4-11, IEC 61000-4-34, CBEMA, ITIC

- Which standard should you use?
- Unbalanced vs. balanced sags on 3-phase systems
- Pass-fail criteria – some practical problems
- Planned revisions to these standards

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Harmonics – IEEE 519

- "Point of Common Coupling" approach
- Customer limits on harmonic currents
- Then utility limits on harmonic voltages
- Rarely a problem to meet requirements

Measurements – IEC 61000-4-30

- "Class A" makes sure the instrument is following the standard
- Ensures compatible readings… avoids arguments.

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POWER QUALITY MEASUREMENT AND MONITORING

Power quality measurement and monitoring

a) Common mistakes and problems
b) Practical rules of thumb: how long should you monitor? How do you choose thresholds? What should you do with the data?
c) Big changes coming in power quality monitors – cheaper, easier, and simpler
d) How to use power flow measurements for sizing UPS, power conditioners

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Big changes coming in power quality monitors – cheaper, easier, and simpler

- Example: PQube® instrument – simple to use, cloud storage, Class A power quality, Class 0.2 energy, micro-SD storage…

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Big changes coming in power quality monitors – cheaper, easier, and simpler

- Example: also monitors temperature, humidity, barometric pressure, acceleration, etc.

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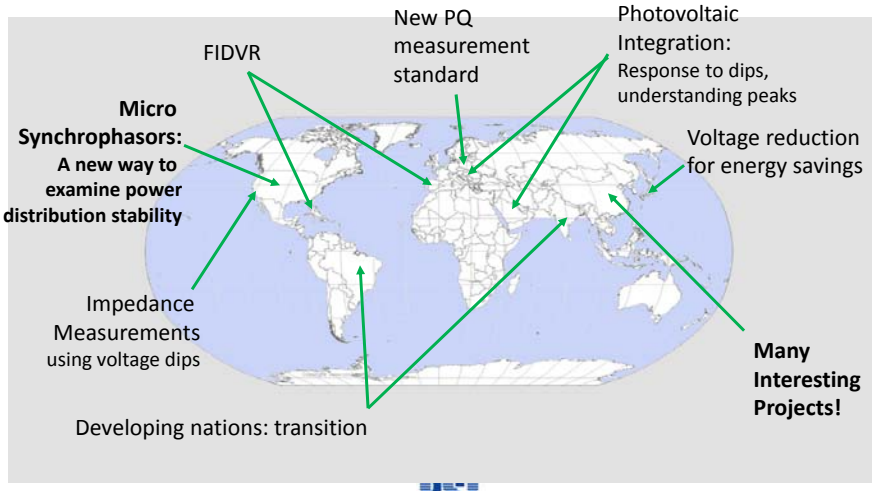
FUTURE OF POWER QUALITY

2013-2014 PQ Developments



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Free worldwide PQ data

- Free up-to-the-minute waveform recordings available at **http://map.PQube.com**

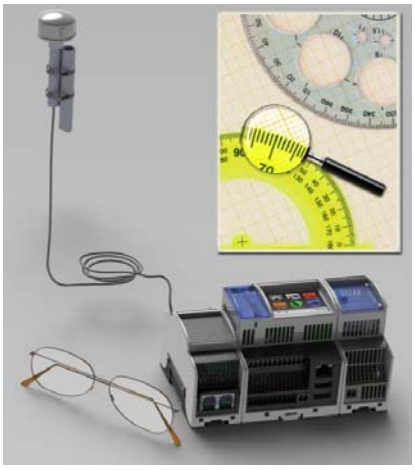
Distributed generation and grid stability: the ARPA-E Microsynchrophasor Project

New low-cost, ultra-high-angular precision instrument –
Power Standards Lab

Developed with funding from
U.S.A. ARPA-E ($4 million)

Optimized for much lower cost compared to traditional synchrophasors

Optimized for distribution measurements, especially with PV and wind turbines –
ultra precise angle measurements



Alex McEachern
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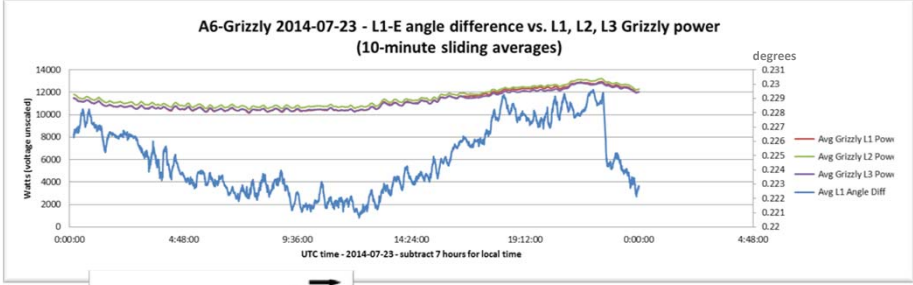
Example application: Cable impedance measurement (for precise fault detection)



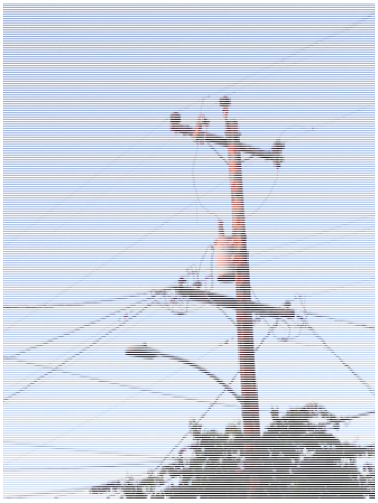
$$\vec{Z}_{source} = \frac{\Delta\vec{V}}{\Delta\vec{I}}$$

$$\vec{Z}_{segment} = \vec{Z}_{end} - \vec{Z}_{begin}$$

(patent pending)

 113

Application: Conductor identification



 114

Alex McEachern
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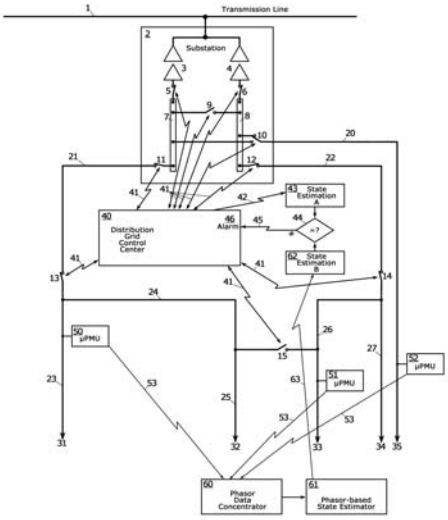
Application: Cyber attack detection



Application: Distributed generation stability

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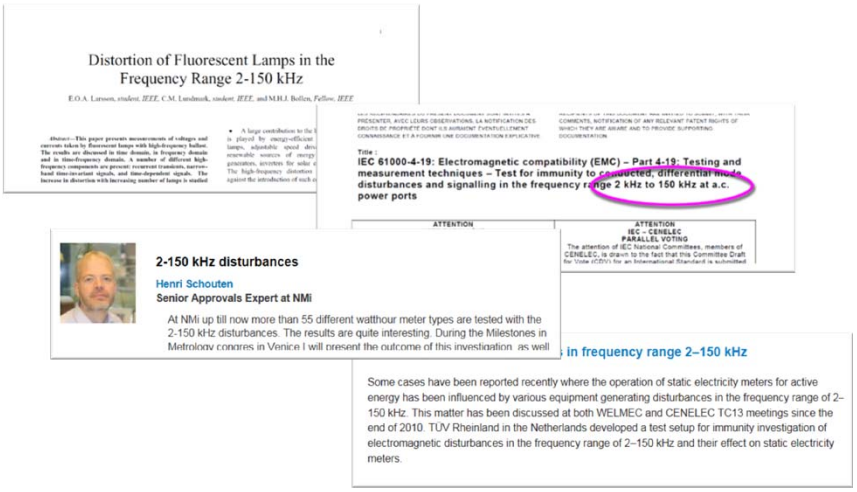
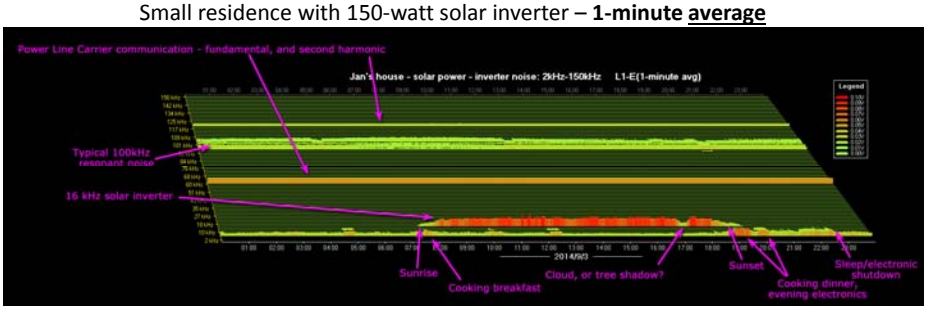
2kHz-150kHz – interesting new PQ problem



 117

2kHz-150kHz – interesting new PQ problem

Small residence with 150-watt solar inverter – **1-minute <u>average</u>**



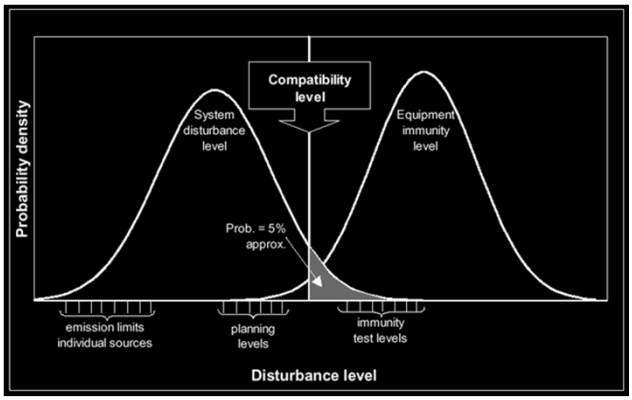
 118

Voltage sag compatibility

- Growing recognition by equipment manufacturers…
- Problem is gradually being solved in newer high-value factories

 119

In the past 40 years, power quality has gotten <u>much</u> better.



So I'm optimistic about the next 40 years!

 120

Alex McEachern
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Search the internet for:

“Power quality relay”

“PQube”

“Power Quality Teaching Toy”

 121

Please send questions !
Alex@PowerStandards.com

Q & A

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Hydro One
2014 Large Customer Conference

Power Quality Seminar

Alex McEachern, Power Standards Lab
Alex@PowerStandards.com

September 24, 2014

Alex McEachern
Alex@PowerStandards.com

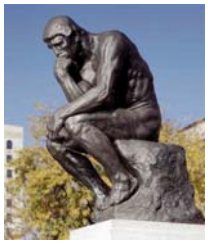
LARGE CUSTOMER CONFERENCE 2015

Practical Power Quality: An Update

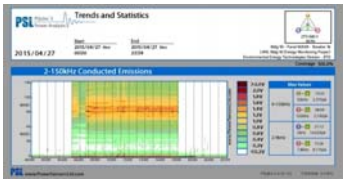
Alex McEachern (responsible for all content)
Alex@PowerStandards.com
President, Power Standards Lab
November 25, 2015

This morning

Ideas for you to think about,
not transferring facts,
so **no note-taking** necessary!

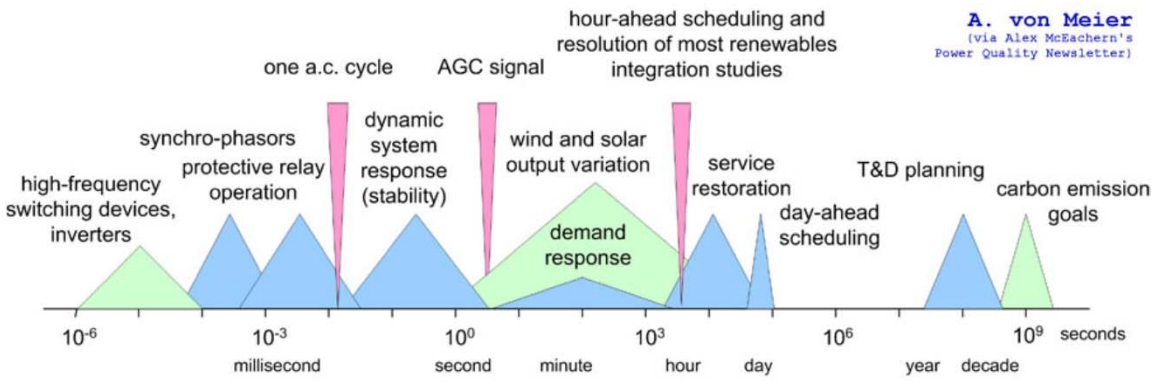


- Time scales on AC power grids
- 2kHz-150 kHz emissions – new power quality
- The concept of "load diversity", and reliability
- Some power quality case studies



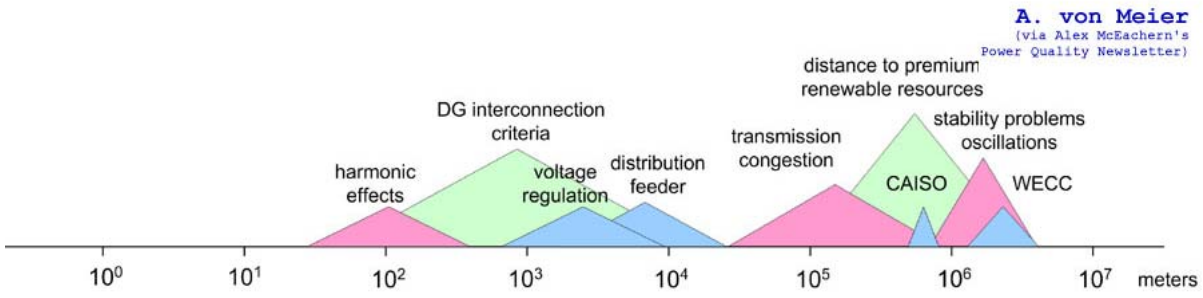
2

Time scales on AC grids



3

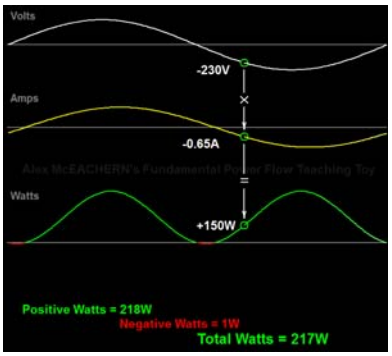
Distance scales on AC grids



4

Time scales on AC grids

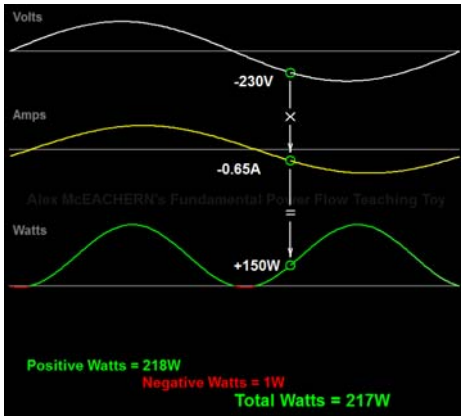
- "What is the voltage?"



5

Time scales on AC grids

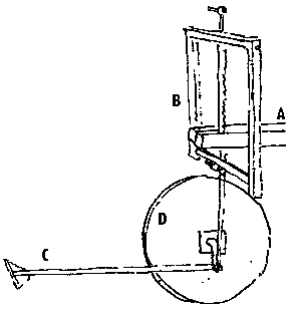
- "Reactive" or "imaginary" power – what is it, exactly?



6

Time scales on AC grids

- "Reactive" or "imaginary" power – Leonardo da Vinci



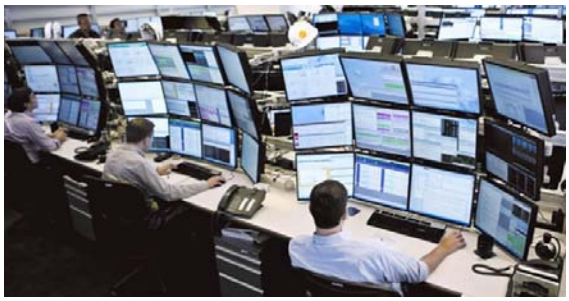
Energy storage for fractions of a cycle…

Time scales on AC grids

- If power is instantaneous, why do utilities think in 15-minute time scale?

Time scales on AC grids

- Why do utilities think in 1-year time scale?



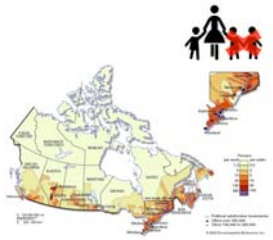
Time scales on AC grids

- Why do utilities think in 30-year time scale?

Time scales on AC grids

- Why do utilities think in 100-year time scale? (Any other institutions?)



PSL

hydro one

Time scales on AC grids

- Why do utilities think in 100-year time scale? (Any other institutions?)
- Quasi-governmental: Markets, regulation, and natural selection

PG&E


PSL

hydro one

Back to technology! Time scales on AC grids

Photovoltaic integration into the grid (where were these photos taken?)



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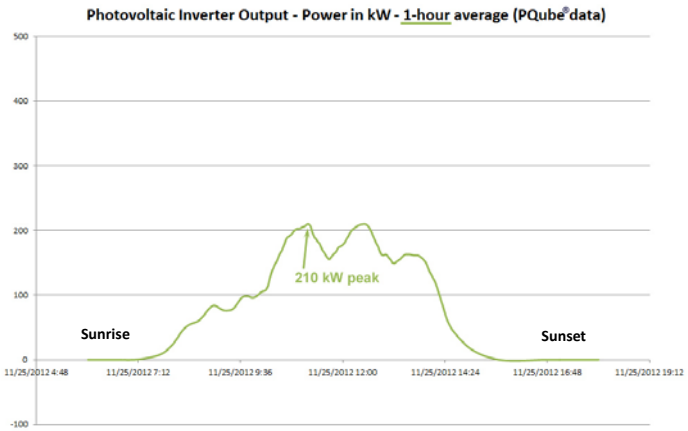
Time scales on AC grids

Photovoltaic integration into the grid – **1 hour**

PQube® instrument

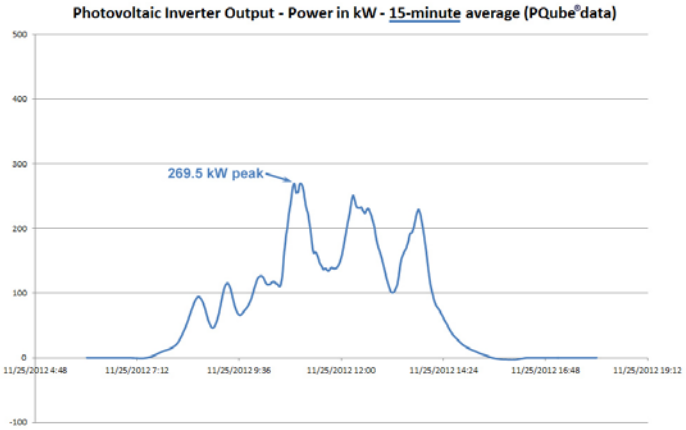


PEAK POWER
1-hour 210 kW

14

Time scales on AC grids

Photovoltaic integration into the grid – – **15 minutes**



PQube® instrument

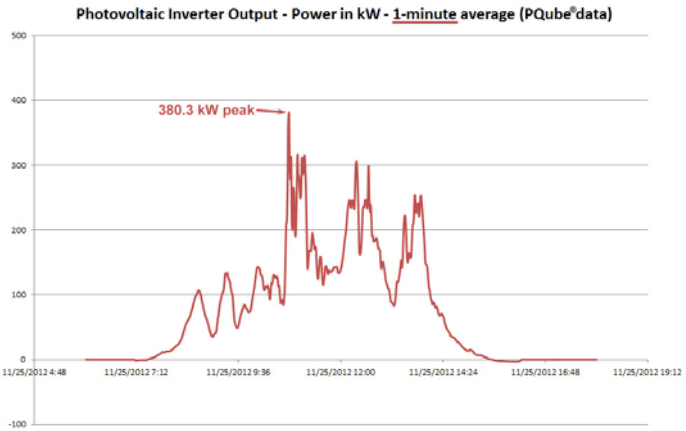
PEAK POWER

1-hour	210 kW
15-min	269 kW

15

Time scales on AC grids

Photovoltaic integration into the grid – **1 minute**



PQube® instrument

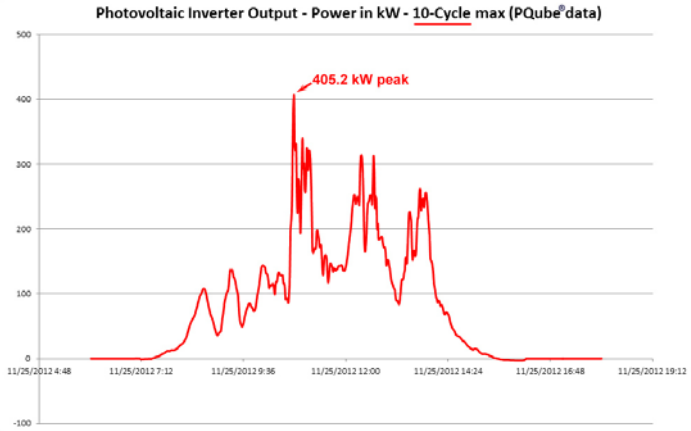
PEAK POWER

1-hour	210 kW
15-min	269 kW
1-min	380 kW

16

Time scales on AC grids

Photovoltaic integration into the grid – **10 cycles**



PQube® instrument

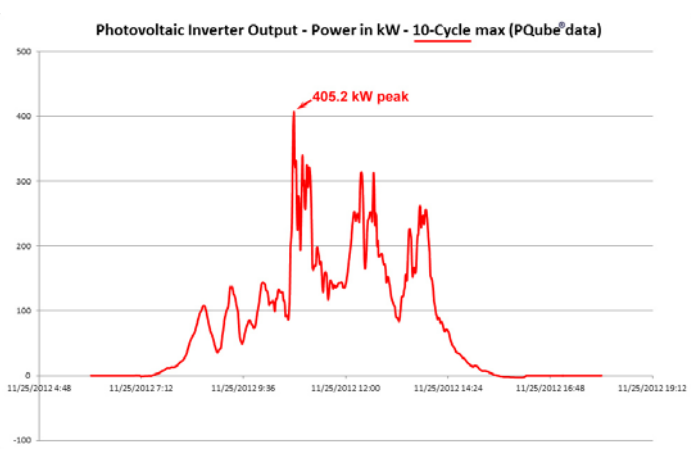
PEAK POWER

1-hour	210 kW
15-min	269 kW
1-min	380 kW
200-ms	405 kW

17

Given the precise match that is required between load and supply,

how should a utility plan for such variable supply?



PQube® instrument

PEAK POWER

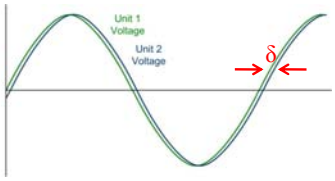
1-hour	210 kW
15-min	269 kW
1-min	380 kW
200-ms	405 kW

18

Time scales on AC grids

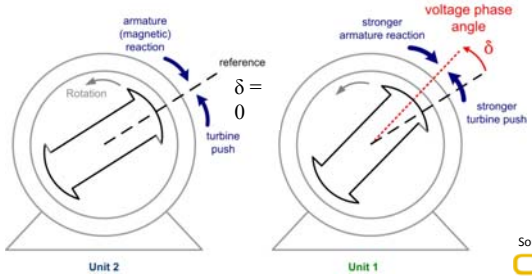
At every instant, Power generated = Power consumed (no storage!)

How AC power generation is controlled



the small phase angle δ between different locations on the grid drives a.c. power flow

$$P \approx \frac{V_1 V_2}{X} \sin \delta_{12}$$



Source: Prof. von Meier, UC Berkeley

Time scales on AC grids

Phase angle, and frequency… where does the instant energy come from?

So: what happens when you turn on a light?

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Time scales on AC grids

Phase angle, and frequency…

<u>This is the main energy storage on a grid:</u>

So: what happens when you turn on a light?

22

Time scales on AC grids

Phase angle, and frequency…

That's why frequency varies: mis-match between all generators, together, and all loads, together.

Best indication of grid stability.

Live meters at

http://Mobile.PQube3.com

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Time scales on AC grids

Phase angle, and frequency…

PV arrays produce DC energy.

Inverters convert DC to AC.

(a) No energy storage in inverters*.

(b) Fast phase-angle response in inverters.

(a) + (b) = opposite characteristics from thermal generator, and imply reduced grid stability…

* Not entirely true…

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A side trip into frequency…

What is frequency, anyway?

This is a dog.

25

A side trip into frequency…

What is frequency, anyway?

These are dogs.

These are dogs(?).

This is not a dog(?).

This is not a dog.

26

A side trip into frequency…

What is frequency, anyway? Just a word?

Maybe Inverse of time-between-zero-crossings?
- How many zero crossings?
- Does frequency exist between zero crossings?

Maybe Rate-of-change of phase angle?
- Between what two points in time? How far apart?
- Disturbed by phase-jumps.

Maybe Maximum energy bin in FFT?
- How wide are the bins?
- What kind of windowing algorithm? What is N in 2^N?

Maybe Best-fit auto-correlation in time?
- We only know frequency after it occurs
- How long to we auto-correlate?

Hint:
The choice of definition
DOESN'T MATTER
if(!) the frequency
Is stable….

A side trip into frequency…

But the definition <u>does</u> matter when the frequency is unstable.

Different devices use <u>different definitions</u>, and:
Different devices use <u>different parameters</u> in their definitions.

"Devices": Over- and under-frequency relays, inverters, Frequency-based load-shedding systems…

The first sign of an unstable grid:
unexplained frequency relay trips.

Time scales on AC grids

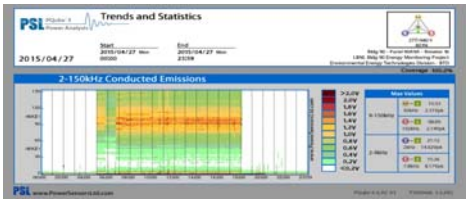
- From fractions of a millisecond, to about 100 years…
- Power consumed = power generated…
- Frequency is a measure of the balance…

ARPA-E micro-synchrophasors (PQube® 3):

an “electron microscope” for distribution grid stability

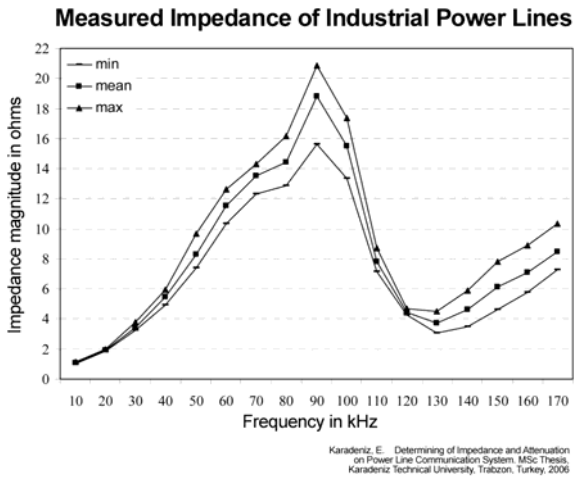
A new, growing power quality problem:

2 kHz – 150 kHz emissions



How 2kHz-150kHz emissions move through the grid:

Grid is designed for 50/60 Hz, but can carry conducted energy up to about 150 kHz.



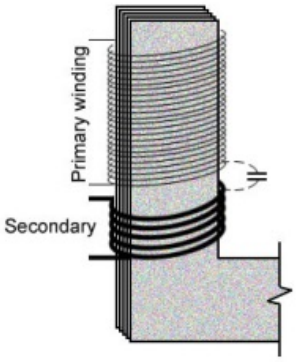
Karadeniz, E. Determining of Impedance and Attenuation on Power Line Communication System. MSc Thesis, Karadeniz Technical University, Trabzon, Turkey, 2006

Peak impedance around 100kHz .

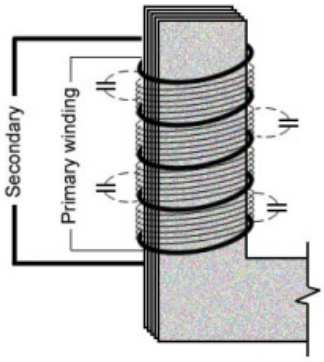
Impedance converts current emissions to voltage emissions...

How 2kHz-150kHz emissions move through the grid:

High-efficiency transformers have larger inter-winding capacitance.



Traditional transformer winding –
Excellent isolation, poor efficiency.
Mostly blocks 2kHz-150kHz



High Efficiency Transformer winding –
Poor isolation, excellent efficiency.
2kHz-150kHz leaks through

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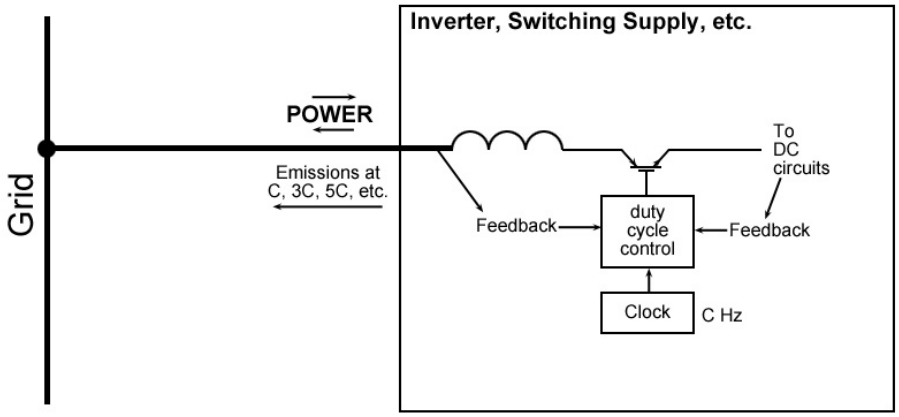
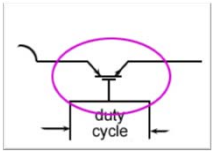
Sources of 2kHz-150kHz emissions

Semiconductor switching… why?



34

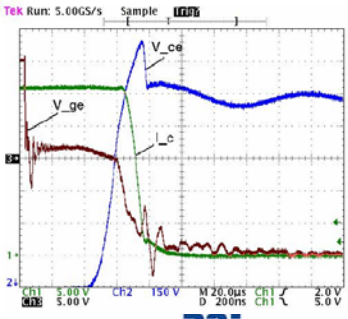
Sources of 2kHz-150kHz emissions
Semiconductor switching… but why? (1)

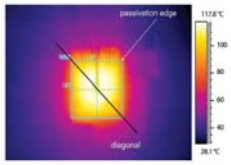


IGBT "off" – voltage, but no current
IGBT "on" – current, but no voltage
IGBT in transition: voltage and current, so big power

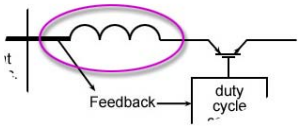
The bigger the IGBT, the slower the transition.

Conclusion: for IGBT efficiency, switching frequency as <u>low</u> as possible…





Sources of 2kHz-150kHz emissions
Semiconductor switching… but why? (2)



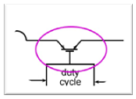
Between switching events, energy is stored in magnetic core of inductor.

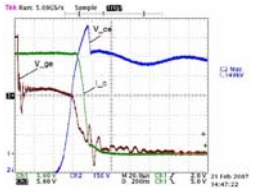
The physical size of the core (and material) determines the maximum energy storage.

Inductors are large and expensive.

Conclusion: for inductor efficiency, switching frequency as <u>high</u> as possible…

Sources of 2kHz-150kHz emissions
Semiconductor switching… but why? (3)





For IGBT efficiency, switching frequency as <u>low</u> as possible… For inductor efficiency, switching frequency as <u>high</u> as possible…

<u>So it is an ECONOMIC compromise.</u>

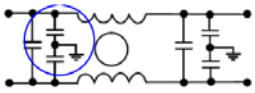
In 2015, for power greater than ~100kW, economic optimum frequency is in 9kHz-20kHz range.

In 2015, for power 1kW~100kW, economic optimum frequency is in 20kHz-100kHz range.

In 2015, for power < 1kW, economic optimum frequency is in 80kHz-1MHz range.

OUCH!
All in 2kHz-150kHz range…

Problems caused by 2kHz-150kHz emissions
1. Excessive **Capacitor currents**



Capacitor (filter) from power grid conductor to earth.

Capacitor designed, for example, for 0,5 mA of current to Earth at 230V, 50 Hz.

Capacitor impedance = $\frac{1}{2\pi F C}$

Just 2.3V at 50 kHz increases capacitor current by a factor of 10!

Increased current destroys capacitors, and increases Earth current (causing protection problems, and possible safety issues).

2kHz-150kHz measurements

61000-4-30, Edition 3 (2015) – PQube 3

The PQube®3 is the <u>only</u> instrument that implements Edition 3: – Full Class A Ed. 3 power quality, certified Class 0.2 energy meter, 8GB storage, 4MHz sampling, email, web, SSL banking-level encryption, temperature/humidity/barometric pressure/acceleration, ~€3 000

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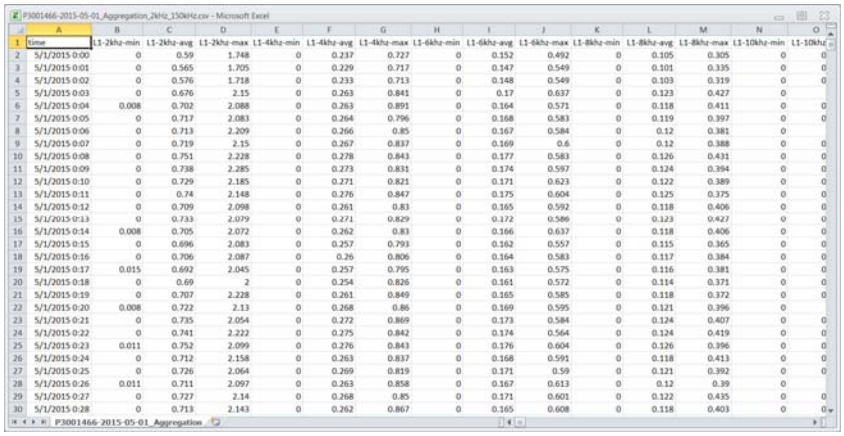
2kHz-150kHz measurements

61000-4-30, Edition 3 (2015)

PQube®3 – no software, internally generated Excel® file, emailed to user



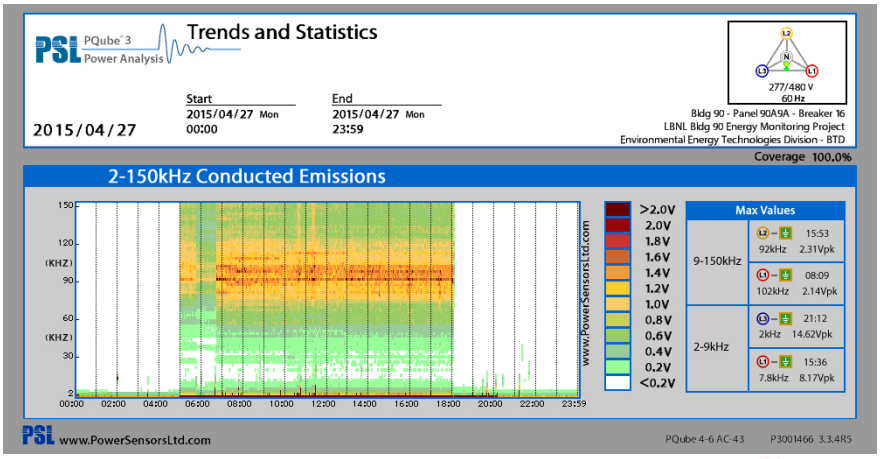
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Time	L1-2khz-min	L1-2khz-avg	L1-2khz-max	L1-4khz-min	L1-4khz-avg	L1-4khz-max	L1-6khz-min	L1-6khz-avg	L1-6khz-max	L1-8khz-min	L1-8khz-avg	L1-8khz-max	L1-10khz-min	L1-10khz
2	5/1/2015 0:00	0	0.59	1.748	0	0.237	0.727	0	0.152	0.492	0	0.105	0.305	0	0
3	5/1/2015 0:01	0	0.565	1.705	0	0.229	0.717	0	0.147	0.549	0	0.101	0.335	0	0
4	5/1/2015 0:02	0	0.576	1.718	0	0.233	0.713	0	0.148	0.549	0	0.103	0.319	0	0
5	5/1/2015 0:03	0	0.676	2.15	0	0.263	0.841	0	0.17	0.637	0	0.123	0.427	0	
6	5/1/2015 0:04	0.008	0.702	2.088	0	0.263	0.891	0	0.164	0.571	0	0.118	0.411	0	0
7	5/1/2015 0:05	0	0.717	2.083	0	0.264	0.796	0	0.168	0.583	0	0.119	0.397	0	0
8	5/1/2015 0:06	0	0.713	2.209	0	0.266	0.85	0	0.167	0.584	0	0.12	0.381	0	
9	5/1/2015 0:07	0	0.719	2.15	0	0.267	0.837	0	0.169	0.6	0	0.12	0.388	0	0
10	5/1/2015 0:08	0	0.751	2.228	0	0.278	0.843	0	0.177	0.583	0	0.126	0.431	0	0
11	5/1/2015 0:09	0	0.738	2.285	0	0.273	0.831	0	0.174	0.597	0	0.124	0.394	0	0
12	5/1/2015 0:10	0	0.729	2.185	0	0.271	0.823	0	0.171	0.623	0	0.122	0.389	0	0
13	5/1/2015 0:11	0	0.74	2.148	0	0.276	0.847	0	0.175	0.604	0	0.125	0.375	0	0
14	5/1/2015 0:12	0	0.709	2.098	0	0.261	0.83	0	0.165	0.592	0	0.118	0.406	0	0
15	5/1/2015 0:13	0	0.733	2.079	0	0.271	0.829	0	0.172	0.586	0	0.123	0.427	0	0
16	5/1/2015 0:14	0.008	0.705	2.072	0	0.262	0.83	0	0.166	0.637	0	0.118	0.406	0	0
17	5/1/2015 0:15	0	0.696	2.083	0	0.257	0.793	0	0.162	0.557	0	0.115	0.365	0	0
18	5/1/2015 0:16	0	0.706	2.087	0	0.26	0.806	0	0.164	0.583	0	0.117	0.384	0	0
19	5/1/2015 0:17	0.015	0.692	2.045	0	0.257	0.795	0	0.163	0.575	0	0.116	0.381	0	0
20	5/1/2015 0:18	0	0.69	2	0	0.254	0.826	0	0.161	0.572	0	0.114	0.371	0	0
21	5/1/2015 0:19	0	0.707	2.228	0	0.261	0.849	0	0.165	0.585	0	0.118	0.372	0	0
22	5/1/2015 0:20	0.008	0.722	2.13	0	0.268	0.86	0	0.169	0.595	0	0.121	0.396	0	
23	5/1/2015 0:21	0	0.735	2.054	0	0.272	0.869	0	0.173	0.584	0	0.124	0.407	0	0
24	5/1/2015 0:22	0	0.741	2.222	0	0.275	0.842	0	0.174	0.564	0	0.124	0.419	0	0
25	5/1/2015 0:23	0.011	0.752	2.099	0	0.276	0.843	0	0.176	0.604	0	0.126	0.396	0	0
26	5/1/2015 0:24	0	0.712	2.158	0	0.263	0.837	0	0.168	0.591	0	0.118	0.413	0	0
27	5/1/2015 0:25	0	0.726	2.064	0	0.269	0.819	0	0.171	0.59	0	0.121	0.392	0	0
28	5/1/2015 0:26	0.011	0.711	2.097	0	0.263	0.858	0	0.167	0.613	0	0.12	0.39	0	
29	5/1/2015 0:27	0	0.727	2.14	0	0.268	0.85	0	0.171	0.601	0	0.122	0.435	0	0
30	5/1/2015 0:28	0	0.713	2.143	0	0.262	0.867	0	0.165	0.608	0	0.118	0.403	0	0

40

2kHz-150kHz measurements

61000-4-30, Edition 3 (2015)

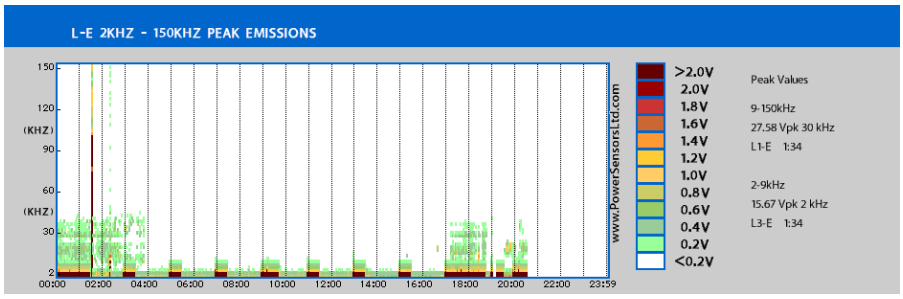
PQube®3 instrument – no software, internally generated graph, automatically emailed to you



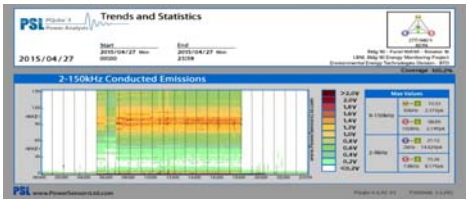
2kHz-150kHz measurements

61000-4-30, Edition 3 (2015)

PQube®3 – no software, internally generated graph, emailed to user

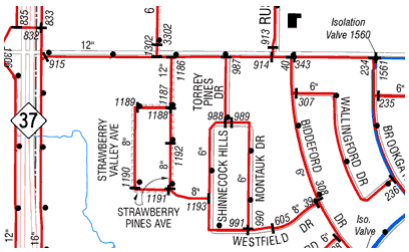


A new, growing power quality problem:
2 kHz – 150 kHz emissions



Understanding an important utility concept:
load diversity

Almost all benefit-to-society infrastructures rely on load diversity.



Water mains…

Public highways…

Power grid…

What happens with inadvertent load synchronization?

After large scale outage, “cold load pickup”

A side note on load diversity and the news: 11/22/2016

"Honey pot"

(Some of the best minds in the utility industry are working on this.)

47

Can you spot the PV problem for load diversity?

Hint – think about partially-cloudy weather on a windy day…

48

How about wind? Or solar thermal?

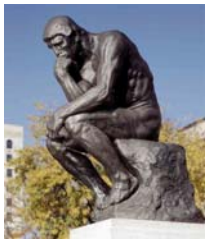
Why is wind easier to integrate than solar PV?

Why is solar thermal easier to integrate than solar PV?

Understanding an important utility concept: **load diversity**

Utility industry ideas…

Well beyond just delivering power!



- Time scales on AC power grids
- 2kHz-150 kHz emissions – new power quality
- The concept of "load diversity", and reliability

- **After the break:** Power quality case studies

LARGE CUSTOMER CONFERENCE 2015

Practical Power Quality: An Update

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November 25, 2015

LARGE CUSTOMER CONFERENCE

2015

Practical Power Quality: Case Studies

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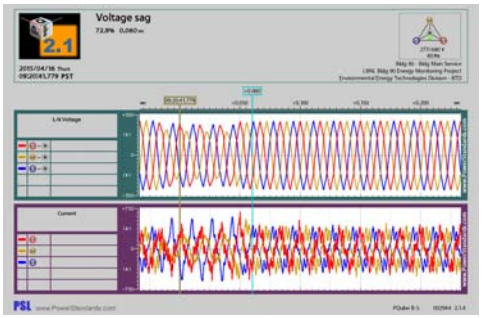
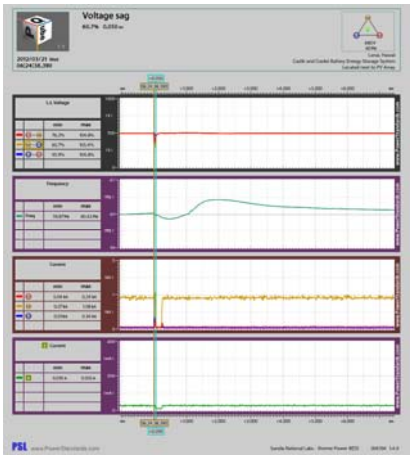
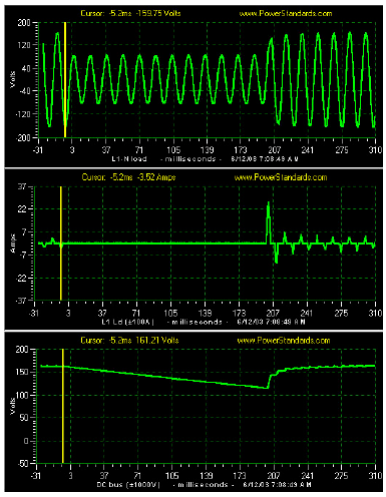
November 25, 2015

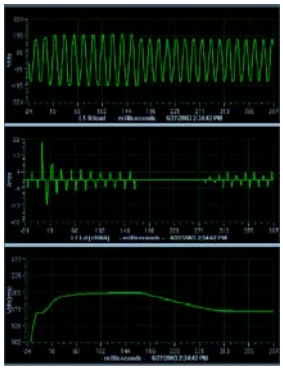
Case studies – voltage sag immunity



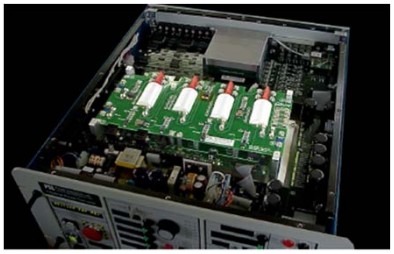


Case studies – voltage sag immunity page 2



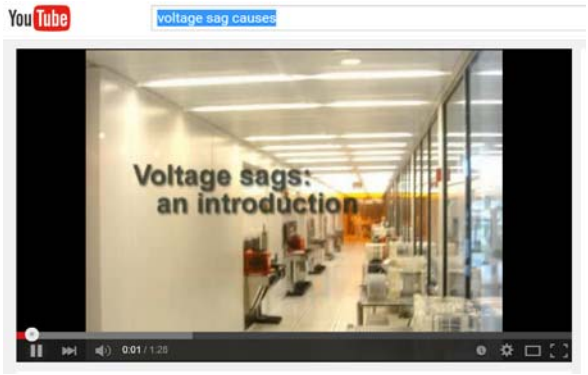


Case studies – voltage sag immunity page 2



Voltage sags happen.

- Brief reduction in voltage – most common power quality problem.



5

What are the costs of voltage sags?

- Incurred costs – can be difficult to measure
- Measurement costs – pretty low
- Solution costs
  - Fundamentally a local problem, and *must* be fixed locally
  - Fundamentally a question of energy storage: density, conversion, release rate, safety, disposal
- Can be solved technically, but what's the least expensive solution?

6

Basic concept of "voltage sag immunity"

What are the cheapest solutions to voltage sags?

1. It isn't a problem – we were mistaken.
2. It's a problem, but we can live with it.
3. It's a problem, but we can fix it easily!
4. Voltage sags only affect certain equipment.
   a. Voltage sags only affect certain parts of certain equipment.
5. We need to get rid of ALL voltage sags.

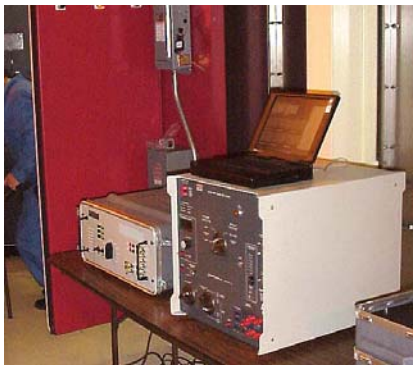
All of these inexpensive solutions start with monitoring.

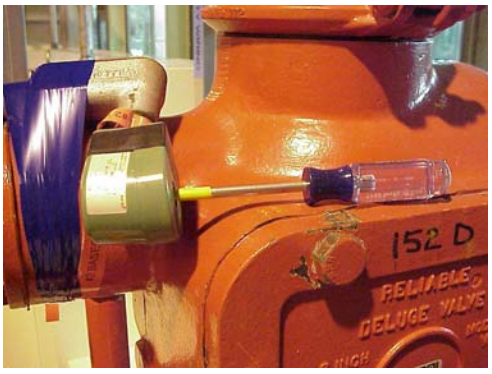
- Simple, easy-to-use monitors these days – PQube for example.
- What are the characteristics of the voltage sags?
  When, how deep, how long? Signatures?
- Have we actually fixed the problem?

Solution #1:

It isn't a problem – we were mistaken.

U.S. automobile manufacturing plant "FACP"





Solution #2:

It's a problem, but we can live with it.

Baby food processing plant

Solution #3:

Voltage sag problem, but we can fix it!

- Rendering plant – get rid of the cause
- VFD – easy-to-reprogram behavior

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(skip Solution #4 for a moment)

Solution #5:

We need to get rid of ALL voltage sags.

- SpaceEx control center
- 380V DC data center
- Cell phone tower
- Caution: *Must* be local, on-site solution
- Caution: very costly
- Caution: solution can even be worse than the problem **(semiconductor plant mistake)**


FACILITY OWNER

The Shift to 380V DC in the Data Center

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Solution #4:

Voltage sag immunity

- Applies when voltage sags only affect certain equipment.
- Applies even more when voltage sags only affect certain PARTS of equipment.
- Why? Goes back to energy storage costs.
- How? Intentionally apply voltage sags to equipment, and fix the problems.

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Solution #4:

Voltage sag immunity: airport

- Case study – Escalator (at China airport)

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Solution #4:

Voltage sag immunity: semiconductor factory

- Case study – semiconductor industry (why?)



PSL

hydro one

Solution #4:

Voltage sag immunity: semiconductor factory



Quick moving!

Few major buyers of equipment…

intel SAMSUNG tsmc SK hynix Micron TI TOSHIBA

Few major sellers of equipment…

APPLIED MATERIALS ASML Lam RESEARCH TEL KLA-Tencor

STANDARDS

IEC 61000-4-34, used in petrochemical, process industries

RESULTS after 10 years

PSL

hydro one

Solution #4:

Voltage sag immunity: oil tanker ship

- Case study – oil tanker ship

Practical solutions for voltage sag problems: summary

1. Monitor first – find out if it is, in fact, a problem.
2. Can it be fixed internally, with almost no effort?
3. Economics second – is it worth fixing, and how much should be invested.
4. Must be solved locally. Brute force solution, or voltage sag immunity solution – both work. Choose based on economics.

LARGE CUSTOMER CONFERENCE 2015

Practical Power Quality: Case Studies

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November 25, 2015

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #018

Reference:

Exhibit B1, Tab 2, Schedule 2, Page 5

Interrogatory:

a) When does the annual Large Customer Conference take place.

b) Please explain how input from the most recent Large Customer Conference is reflected in the current application.

Response:

a) Hydro One's 2015 Large Customer Conference took place from November 25th to 26th. The 2016 Large Customer Conference is scheduled for the period November 21th to 22th.

b) The Large Customer Conference is designed primarily as a venue to provide information to customers on Hydro One initiatives and industry topics of interest and to ask for customer input on issues, facilitating direct communication with Hydro One's senior executives. Customer input from the 2015 conference resulted in follow-up actions such as: a review of the planned outage scheduling process with respect to input from generators; increased emphasis on timely communications; and continued development of the power quality program. With the exception of power quality, customer input focused on process and operational topics, which were addressed through the refinement of existing activities. As such, they are not specifically identified in this application.

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #019

Reference:

Exhibit B1, Tab 2, Schedule 2, Page 7 & Attachment 1

Interrogatory:

a) Please identify the significant changes to Hydro One's proposed investment plan as a result of the Customer Engagement Work in the Spring of 2016 and the results of the consultation documented in the report prepared by Ipsos Reid (Attachment 1).

Response:

Please refer to BOMA #36 (Exhibit I, Tab 2, Schedule 36).

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #020

Reference:

Exhibit B1-2-2, Attachment 2 Transmission Customer Engagement: Investing for the Future March 2016, Slide 9

Interrogatory:

Preamble: Equipment performance is the largest controllable factor, contributing 42% of system interruption minutes.

a) Please confirm the year the data in above statement refers to.

b) Please show how the 42% is derived.

Response:

a) Over the 2011 to 2015 period, equipment failures accounted for an average of 42% of the interruption minutes on the Hydro One transmission network.

b) The 42% is derived from analyzing the primary cause identified for each delivery point interruption, then summating the interruption minutes for those interruptions that were identified as “EQUIPMENT” failure caused to the overall total interruption minutes.

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #021

Reference:

Exhibit B1-2-2, Attachment 2 Transmission Customer Engagement: Investing for the Future March 2016, slides 11-12

Interrogatory:

a) For the Multi-Circuit System, please complete the following Table:

Contribution to SAIDI*	**2011**	**2012**	**2013**	**2014**	**2015**
% equipment					
% tree contact					

* excluding planned interruptions, interruptions due to customer activity and Force Majeure events.

b) For the Multi-Circuit System, please complete the following Table:

Contribution to SAIFI*	**2011**	**2012**	**2013**	**2014**	**2015**
% equipment					
% tree contact					

* excluding planned interruptions, interruptions due to customer activity and Force Majeure events.

c) For the Single-Circuit System, please complete the following Table:

Contribution to SAIDI*	**2011**	**2012**	**2013**	**2014**	**2015**
% equipment					
% tree contact					

* excluding planned interruptions, interruptions due to customer activity and Force Majeure events.

d) For the Single-Circuit System, please complete the following Table:

Contribution to SAIFI*	**2011**	**2012**	**2013**	**2014**	**2015**
% equipment					
% tree contact					

* excluding planned interruptions, interruptions due to customer activity and Force Majeure events.

Response:

a) For the Multi-Circuit System:

Contribution to SAIDI*	**2011**	**2012**	**2013**	**2014**	**2015**
% equipment	67%	57%	49%	29%	56%
% tree contact	19%	9%	0%	0%	0%

* excluding planned interruptions, interruptions due to customer activity and Force Majeure events.

b) For the Multi-Circuit System:

Contribution to SAIFI*	**2011**	**2012**	**2013**	**2014**	**2015**
% equipment	37%	24%	20%	16%	35%
% tree contact	3%	1%	1%	1%	0%

* excluding planned interruptions, interruptions due to customer activity and Force Majeure events.

c) For the Single-Circuit:

Contribution to SAIDI*	**2011**	**2012**	**2013**	**2014**	**2015**
% equipment	21%	74%	31%	51%	53%
% tree contact	15%	11%	8%	4%	12%

* excluding planned interruptions, interruptions due to customer activity and Force Majeure events.

d) For the Single-Circuit System:

Contribution to SAIFI*	**2011**	**2012**	**2013**	**2014**	**2015**
% equipment	20%	13%	14%	11%	11%
% tree contact	5%	4%	2%	2%	3%

* excluding planned interruptions, interruptions due to customer activity and Force Majeure events.

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #022

Reference:

Exhibit B1-2-2, Attachment 2 Transmission Customer Engagement: Investing for the Future March 2016, slide 13

Interrogatory:

a) Please provide the contribution to equipment related interruption duration by asset class (system wide) separately for the years 2011 to 2015.

Response:

a) See below for summary (by Asset Class) of the duration of equipment related interruptions. Asset classes are shown as a percentage of the annual total equipment percentage (i.e., in 2011, of the total interruption minutes due to equipment failure causes, LINE EQP accounted for 60.7% of the total interruption minutes that year). The top four categories were those identified in the Customer Engagement slide 13 noted above in the reference.

Asset Class	2011	2012	2013	2014	2015	5-Yr Avg
LINE EQP	60.7%	75.9%	63.0%	75.5%	75.2%	68.6%
TRANSFORMER	7.8%	2.9%	17.3%	10.2%	1.5%	8.6%
PROTECTION	15.1%	6.8%	2.6%	5.5%	2.0%	6.7%
BREAKER	9.1%	9.8%	3.6%	5.5%	5.1%	6.4%
SWITCH	3.7%	1.4%	10.4%	1.6%	1.7%	4.3%
IT (CVT, CT, PT)	0.9%	0.2%	0.7%	0.0%	5.4%	1.6%
BUS	1.3%	0.2%	1.8%	0.9%	2.4%	1.4%
SURGE ARRESTOR	0.3%	0.0%	0.0%	0.0%	5.3%	1.2%
UNKNOWN	0.8%	0.0%	0.0%	0.0%	1.4%	0.5%
OTHER	0.0%	2.3%	0.0%	0.9%	0.0%	0.5%
CABLE	0.2%	0.6%	0.5%	0.0%	0.0%	0.3%
	100.00%	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

Witness: Mike Penstone

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #023

Reference:

Exhibit B1-2-2, Attachment 2 Transmission Customer Engagement: Investing for the Future March 2016, slide 15

Interrogatory:

a) Please explain spike in unplanned outage hours due to equipment failure in 2015.

Response:

a) In 2015, approximately 20-25% of the total 272,000 unplanned outage hours was due to capacitor banks being out of service for long durations that were initially caused by failures of equipment associated with the capacitor. The requirement of a capacitor bank for support of local and network voltage control considers many factors: peak load, upcoming outage needs, contingency management and outage coordination availability. In cases where local reactive power was needed to support peak load, capacitors were returned to service expeditiously. In other cases where voltage support was not immediately required, resources were reallocated to more critical sustainment or capital work on the transmission network.

Witness: Mike Penstone

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #024

Reference:

Ref: Exhibit B1-2-2, Attachment 2 Transmission Customer Engagement: Investing for the Future March 2016, slide 20-21

Interrogatory:

a) Please compare Hydro One's proposed investment plan in the application to Scenario's One, Two and Three in terms of expenditure level and risk.

Response:

Please refer to Board Staff #15.d and Exhibit B1, Tab 2, Schedule 4, Page 8, Table 1.

The scenarios presented are the total spending and changes in risk over a 5 year period, while the application is for a two year period, so they are not directly comparable. If considered on an average annual basis, 2017 and 2018 are near Scenario 2.

Witness: Mike Penstone

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #025

Reference:

Exhibit B1, Tab 3, Schedule 1, Attachment 1, Page 2

Interrogatory:

Preamble: Hydro One proposes to spend $2.1 million on Customer Power Quality under Development Capital in each of the years 2016, 2017 and 2018.

a) Please provide a breakdown of the budget for each year.

b) Please provide Hydro One's current definition of power quality.

c) Please discuss how Hydro One identifies and measures a power quality event.

Response:

a) Please see table below for a breakdown of the capital expenditure forecast associated with the Customer Power Quality program.

Item	**Forecast Capital Expenditure ($ Millions)**		
	2016	**2017**	**2018**
Installation of additional power quality meters	0.7	0.7	0.7
Installation of capacitor switchers with transient suppression	1.4	1.4	1.4
Total	**2.1**	**2.1**	**2.1**

b) Hydro One uses the Power Quality definition adopted by the Power Quality Working Group which has been defined as:

> "*Power Quality (PQ) is defined as any power problem manifested in voltage, current, or frequency deviations that result in failure or misoperation of utility or end user equipment*".

This definition has been documented in the "CEATI's PQ Reference Guide for Customers and Utility Representatives" that can be found at the following website.

http://www.hydroone.com/IndustrialLDCs/Pages/PowerQualityProgram.aspx

Witness: Bing Young

c) Hydro One has a growing network of 345 permanently installed Power Quality ("PQ") meters at a number of transmission stations across the province. These PQ meters automatically measure and record power quality performance metrics including voltage sags, harmonics and flicker. This monitoring data is then used to assess and identify potential power quality events.

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #026

Reference:

Exhibit B1, Tab 2, Schedule 2

Interrogatory:

Preamble: Hydro One indicates it has included evaluating assets that may be run-to-failure candidates (those not directly affecting transmission reliability) as part of its ongoing activity to address reliability risk.

a) Please list the assets that Hydro One currently runs to failure.

b) Please identify potential new assets that may be run-to-failure candidates.

Response:

Under the integrated stations investment model Hydro One replaces assets at or near end of life in the station under one investment. Other less critical assets which do not drive the decision for integrated stations investment can be considered run to failure until such time that the critical assets required for replacement. Given this context the questions are answered as follows:

a) Lightning arresters, insulators, revenue metering, bus, station access roads, hookstick switches, capacitor bank cans.

b) Hydro One is still evaluating potential opportunities.

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #027

Reference:

Exhibit B1, Tab 2, Schedule 4, Page 3

Interrogatory:

a) Please provide the major sustaining capital categories that make up each of the expenditures by outcome shown in Figure 1.

Response:

a) The expenditures by outcome shown in Figure 1 in Exhibit B1, Tab 2, Schedule 4 are composed of the following major sustaining capital categories;

- **Maintain System Reliability**
  - Lines
    - Overhead Lines Refurbishment Projects, Component Replacement Programs and Secondary Land Use Projects
    - Underground Cables Refurbishment and Replacement
  - Stations
    - Protection & Automation
    - Integrated Stations Investments
    - Site Facilities and Infrastructure
    - Transmission Station Demand & Spares

- **Ensure Generator Availability**
  - Lines
    - Overhead Lines Refurbishment Projects, Component Replacement Programs and Secondary Land Use Projects
  - Stations
    - Integrated Stations Investments

- **Mitigate Worker and Public Safety Risk**
  - Lines
    - Overhead Lines Refurbishment Projects, Component Replacement Programs and Secondary Land Use Projects
  - Stations
    - Protection & Automation
    - Integrated Stations Investments

- **Address Customer Needs and Preferences**
  - Lines
    - Overhead Lines Refurbishment Projects, Component Replacement Programs and Secondary Land Use Projects
  - Stations
    - Protection & Automation
    - Integrated Stations Investments

- **Comply with Regulatory Obligations**
  - Stations
    - Protection & Automation

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #028

Reference:

Exhibit B1, Tab 2, Schedule 4, Attachment 1

Interrogatory:

a) Page 4: Please provide the year the level of reliability risk is expected to fall to 1.03% for conductors.

b) Page 4: Please provide the level of reliability risk in 2017 for transmission lines and breakers and the expected reliability risk after planned work and the corresponding year.

Response:

a) At the end of 2018.

b)

Hazard Rate

	Jan. 1, 2017	**End of Rate Filing Period(2018)**
Conductors	1.06%	1.03%
Breakers	2.61%	2.63%

Witness: Mike Penstone

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #029

Reference:

Exhibit B1, Tab 2, Schedule 4, Page 8

Interrogatory:

Preamble: Table 1 provides the Relative Change in Reliability Risk from January 1, 2017 to December 31, 2018 as per the proposed investment level.

a) Please provide the % of interruption duration for lines, transformers, breakers and other for 2015.

b) Please provide the interruption duration in minutes for Lines, Transformers, Breakers and Other for each of the years 2010 to 2015.

c) Please provide the underlying calculations including all assumptions to arrive at the values in columns 1 and 2.

Response:

a) To clarify, Table 1 - Relative Change in Reliability Risk, for the column titled "% of Interruption Duration", this is the most recent 5 year average for the listed asset classes, and therefore contains the data over the timeframe 2011-2015. The 2015 values for these are:

Asset Class	**2015**
LINE EQP	75.2%
TRANSFORMER	1.5%
BREAKER	5.1%
OTHER	18.2%

Witness: Mike Penstone

b) As clarified in a) above, values in this Table 1 are for the timeframe 2011-2015, and do not include 2010 values. Interruption duration in minutes for the asset classes in question and over the applicable 2011-2015 timeframe are as follows:

Asset Class	2011	2012	2013	2014	2015	5-Yr Avg.
LINE EQP	15153	9790	15275	11842	15123	13437
TRANSFORMER	1955	373	4199	1605	298	1686
BREAKER	2269	1265	864	861	1019	1255
OTHER	5595	1476	3910	1383	3666	3206

c) Please refer to Board Staff 15a (I-01-015a).

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #030

Reference:

Exhibit B Tab 2 Schedule 6

Interrogatory:

a) Please complete the attached Excel spreadsheet.

b) Please provide a live excel spreadsheet with the response.

Response:

Hydro One has completed the excel spreadsheet as requested and included it as an attachment to this response.

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #031

Reference:

Exhibit B Tab 2 Schedule 6

Interrogatory:

a) Please complete the attached Excel spreadsheet.

b) Please provide a live excel spreadsheet with the response

Response:

Hydro One has completed the excel spreadsheet as requested and included it as an Attachment to this response.

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #032

Reference:

Exhibit B Tab 2 Schedule 6 Page 4

Interrogatory:

Preamble: Hydro One indicates it uses a normal expected service life (ESL) defined as the average time in years that an asset can be expected to operate under normal system conditions.

a) Please confirm the CEA and Hydro One's transmission peers use the same definition for ESL as Hydro One currently uses.

b) When did Hydro One begin using ESL defined as the average time in years that an asset can be expected to operate under normal system conditions?

c) If Hydro One has implemented a new definition of ESL in this application, please provide the definition used in previous years back to 2010.

Response:

a) An explicit definition for ESL could not be verified for the CEA.

b) In Hydro One's previous application EB-2012-0031.

c) Hydro One has not implemented a new definition of ESL in this filing.

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #033

Reference:

Exhibit B Tab 2 Schedule 6

Interrogatory:

a) Please identify all new asset replacement strategies brought forward since 2014.

Response:

a) Increased utilization of integrated investment approach, CP/COB insulator replacement acceleration, and tower coating program are the only new strategies brought forward since 2014.

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #034

Reference:

Exhibit B Tab 2 Schedule 6

Interrogatory:

a) Please provide the Reactive/Emergency capital budget and actuals for the years 2010 to 2015.

b) Please provide a detailed summary of the assets replaced on an emergency basis each year.

Response:

a) The Emergency capital budget and actuals for the years 2010 to 2015 as follows:

Transformer Demand Replacements 2010-2015

	2010	2011	2012	2013	2014	2015
Actual	0.9	6.7	17.3	7.5	6.9	10.0
Forecast	4.5	3.4	3.4	3.5	6.2	6.3

b) The summary of the assets replaced on an emergency basis each year are summarized below.

Breaker Demand Capital Replacements:

Device Type	Year	Location	Breaker	Voltage Class	Type	Age at failure	Mfr	Model
Breaker	2010	Manby	H1L15	230	OIL	32	CGE	FGK
Breaker	2011	Bramalea	SC3J	44	SF6	21	SIEM	SP
Recloser	2011	Crosby	M5	28	OIL	21	ME	ME3A
Breaker	2011	Seaforth	DT2L18	115	OIL	42	CGE	KSO
Breaker	2011	Seaforth	DT1L7	115	OIL	42	CGE	KSO
Breaker	2011	Seaforth	KT1L7	115	OIL	42	CGE	KSO
Breaker	2011	Seaforth	KT2L18	115	OIL	42	CGE	KSO
Recloser	2011	Crosby	M6	28	OIL	21	ME	ME3A
Breaker	2012	St. Thomas	T2Q	27.6	OIL	60	CW	BJOB
Breaker	2012	Fairchild	BSC1	27.6	SF6	22	SIEM	SP
Breaker	2014	Minden	M3	44	OIL	58	CGE	KSO
Breaker	2014	Wanstead	M2	28	OIL	65	CW	BJOB
Breaker	2015	Hinchinbrooke	AL1	230	OIL	41	CGE	FGK
Breaker	2015	Bruce A	T2L5	230	AIR BLAST	43	CGE	AT
Breaker	2015	Bruce A	T2L27	230	AIR BLAST	43	CGE	AT
Breaker	2015	Lake TS	M81	14	AIR-MAGNETIC	33	PION	DST2
Breaker	2015	Scarboro	T23B	28	OIL	44	CGE	KSO
Breaker	2015	Gardiner TS	SC1B	44	OIL	44	CGE	KSO
Breaker	2015	Kirkland Lake	T12E	44	OIL	67	CGE	KSO
Breaker	2015	Gardiner TS	SC2Y	44	OIL	43	CGE	KSO

Transformer Demand Capital Replacements:

Year	Location	Transformer	Voltage Class	Type	Date	Age at Failure	Mfr
2010	Wallaceburg	T3	115	Step-down	31-Mar-10	60	CGE
2010	Essa Ts	T3 (B)	500	Auto	1-Jun-10	38	CW
2011	Hanover	T4	230	Auto	11-Feb-11	20	CGE
2011	Richview	T7	230	Step-down	11-Mar-11	55	FP
2011	Richview	T8	230	Step-down	11-Mar-11	52	CGE
2011	Wallaceburg	T4	115	Step-down	13-May-11	61	CGE
2011	Lisgar	T2	115	Step-down	11-Oct-11	43	PION
2011	Terauley	T4	115	Step-down	1-Nov-11	31	PION
2012	Hanmer	T6 (W)	500	Auto	12-Feb-12	40	CGE
2012	Strathroy	T2	115	Step-down	12-Aug-12	58	CGE
2013	Brant	T2	115	Step-down	1-Feb-13	56	CGE
2013	Thorold	T2	115	Step-down	1-Apr-13	43	PION
2013	Keith	T22	230	Step-down	1-Jun-13	41	CW
2013	Almonte	T3	230	Step-down	1-Sep-13	43	CW
2014	Kenilworth	T2	115	Step-down	26-Mar-14	49	FP
2014	Birch	T3	115	Step-down	25-Apr-14	43	CW
2014	Stewartville	T7	115	Step-down	10-Aug-14	63	CGE
2014	Orillia	T1	230	Step-down	3-Nov-14	39	CW
2014	Trafalgar	T15	500	Auto	4-Jun-14	9	ABB
2015	Orillia	T1	230	Step-down	17-Jan-15	1	PION
2015	Bridgman	T6	115	Step-down	13-Feb-15	60	CW
2015	Lorne Park	T1	230	Step-down	10-May-15	40	PION
2015	Hanmer	T9 (B)	500	Auto	4-Sep-15	42	CGE

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #035

Reference:

Exhibit B Tab 2 Schedule 6

Interrogatory:

a) Please provide the total number of assets replaced in 2014 and 2015 that were within their ESL.

Response:

For transmission lines, the only assets replaced in 2014 and 2015 before their ESL are defective OB/CP insulators. For the quantity of these insulators replaced in each year, please refer to table 12 in Exhibit B1, Tab 2, Schedule 6.

Total number of assets within ESL Replaced:

Assets	**2014**	**2015**
Breakers	99	37
Transformers	8	12

Witness: Chong Kiat Ng

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #036

Reference:

Exhibit B Tab 2 Schedule 6 Page 6 Figure 3

Interrogatory:

a) Please show the calculation #of outages/Component year for each year.

b) Please explain the spike in 2015.

c) Please complete the following Table:

Transformers	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
# Forced Outages										
# Planned Outages										
Total Outages										
Duration of Forced Outages (hours)										

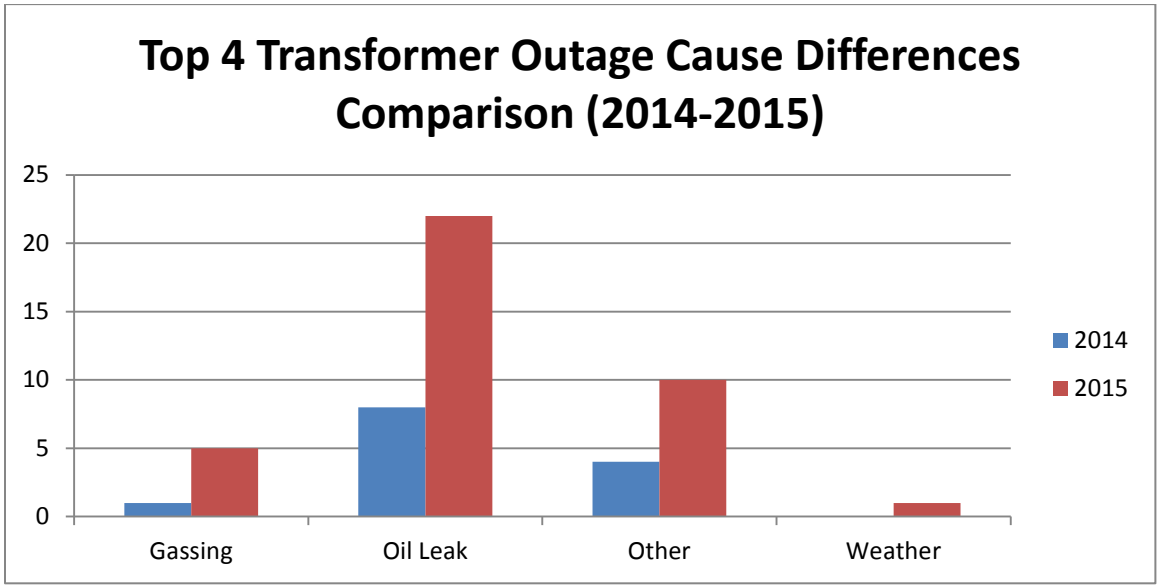
Response:

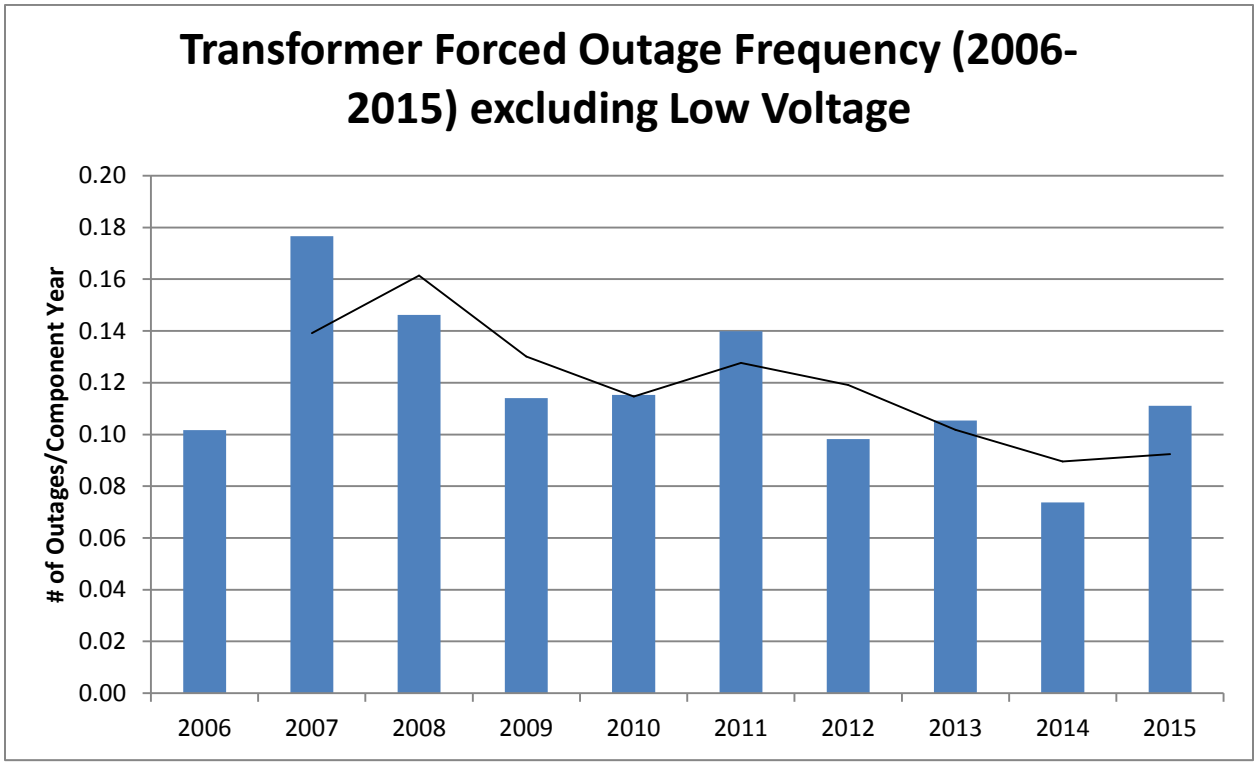
a)

Transformers	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
# of Forced Outages	72	126	106	82	83	101	71	76	54	80
Component Year	708.2	713.7	725.4	719.3	720.0	722.0	723.0	721.0	732.2	729.2
# of Outages/Component Year	0.10	0.18	0.15	0.11	0.12	0.14	0.10	0.11	0.07	0.11

b) The spike in 2015 is explained primarily by an increase of oil leak incidents, forcing the units from service for oil top-up and/or repair. The chart below summarizes the top 4 outage cause categories that contributed to the spike. However, over the 10 year period, 2015 observed forced outages aligns well with the historical average. A moving average trend-line has been

super-imposed on Figure 3 from Exhibit B, Tab 2, Schedule 3 in this response to show relative changes in Transformer Force Outage Frequency.





c)

Transformers	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
# Forced Outages	72	126	106	82	83	101	71	76	54	80
# Planned Outages	1047	987	1047	1230	1012	996	908	769	880	800
Total Outages	1119	1113	1153	1312	1095	1097	979	845	934	880
Duration of Forced Outages (hours)	20644	13739	14000	14993	15268	39777	23630	10688	8171	20596

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #037

Reference:

Exhibit B Tab 2 Schedule 6 Page 6 Figure 8

Interrogatory:

a) Please explain the spike in 2013.

b) Please complete the following Table:

Circuit Breakers	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
# Forced Outages										
# Planned Outages										
Total Outages										
Duration of Forced Outages (hours)										

Response:

a) Please refer to Exhibit I, Tab 1, Schedule 37, Part c).

b)

Circuit Breakers	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
# Forced Outages	143	125	116	132	133	134	119	193	188	175
# Planned Outages	1073	1395	963	1088	1062	985	779	881	1071	957
Total Outages	1216	1520	1079	1220	1195	1119	898	1074	1259	1132
Duration of Forced Outages (hours)	22755	34838	9846	18776	29240	35181	51238	41684	53768	56303

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #038

Reference:

Exhibit B Tab 2 Schedule 6 Page 26 Figure 16

Interrogatory:

a) Please define terminal year.

b) Please show the calculation # of outages/component per terminal year.

Response:

a) The following definition is taken from the CEA Annual Report "Forced Outage Performance of Transmission Equipment".

Terminal Years: The summation of the product of the number of terminals and the period duration in years, for the transmission lines or cables under consideration.

b) The graph represents both station components and line terminals. For stations components, the vertical axis has the "# outages per component year". For line terminals, the vertical axis labelled "# outages per terminal year".

outages per component year = (total number of outages)/(component years)
outages per terminal years = (total number of outages)/(terminal years)

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #039

Reference:

Exhibit B Tab 2 Schedule 6 Page 34 Figure 23

Interrogatory:

a) Please explain the spike in 2015.

Response:

a) The abnormal outage duration in 2015 is mainly due to down conductors on railway tracks and a municipal road on A6R which required extensive coordination with Railway Company and other organizations such as Ottawa Hydro and Transalta Cogen to restore the circuit.

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #040

Reference:

Exhibit B Tab 2 Schedule 6 Page 41

Interrogatory:

a) Please complete the following Table:

Woodpole	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
# Forced Outages	16	25	18	7	18	10	11	8	9	4
Duration of Forced Outages (hours)	709.6	1010.1	697.5	124.5	2338.6	466.4	906.4	316.4	198.9	87.9

Response:

Please see above table.

Witness: Chong Kiat Ng

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #041

Reference:

Exhibit B Tab 2 Schedule 6

Interrogatory:

a) Page 49: Please provide the total number of steel towers in high corrosion environments.

a) Page 51: Please explain the spike in outages in 2011.

b) Page 54 Table 11: Please complete the following Table:

Steel Towers	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
# Replaced	0	17	0	0	0	0	0
# Coated	226	218	121	300	462	1250	1600
Budget $M Replaced	0	5.7	0	0	0	0	0
Budget $M Coated	1.6	separate costs not available	5.1	4.6	8.8	42.5	54.4

Response:

a) Approximately 13,000 - Please refer to Exhibit B1, Tab 2, Schedule 6, section 3.3.3, page 47.

b) The outage duration spike in 2011 is mainly due to failed towers on a double-circuit line which resulted in high outage duration to restore the circuits.

c) This program manages the tower coating and occasional tower member replacement needs. A complete tower replacement is very uncommon and is being managed separately as a project. The provided quantities and costs in Table 11 under Exhibit B1, Tab 2, Schedule 6 and Table 16 under Exhibit B1, Tab 3, Schedule 2 are for tower coating program in the test years. Please see above Table.

Witness: Chong Kiat Ng

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #042

Reference:

Exhibit B1 Tab 3 Schedule 2 Page 2 Lines 1 to 7

Interrogatory:

a) Please explain the difference between ESL and EOL related to how these terms are used by Hydro One to inform its specific investment decisions and proposed spending level.

b) Please provide the units used for Expected Service Life (ESL) and End of Life (EOL).

Response:

a) Expected Service Life (ESL) is used for assessing future asset population sustainment requirements while asset end of life (EOL) is used to determine specific asset replacement requirements using the asset risk assessment process as documented in Exhibit B1, Tab 2, Schedule 5.

b) The units for ESL is age in years. There are no units for EOL as it is a state of asset condition.

Witness: Mike Penstone

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #043

Reference:

Exhibit B1 Tab 2 Schedule 6 Page 36

Interrogatory:

Preamble: With respect to the capital replacement of conductors, the evidence states "The circuits being addressed in the bridge and test years have all reached end of life verified through testing and condition assessment."

a) Please explain what is meant by end of life and if it differs from End of Service Life used by Hydro One.

Response:

As found in in Exhibit B1 Tab 3 Schedule 2, page 2 "End of Life" or "EOL" is defined as "the likelihood of failure, or loss of an asset's ability to provide the intended functionality, wherein the failure or loss of functionality would cause unacceptable consequences."

The term "End of service Life" is identical to End of Life. However, this terminology defers from Expected Service Life (ESL).

ESL is also defined in Exhibit B1 Tab 3 Schedule 2, page 2 as "the average time in years that an asset can be expected to operate under normal system conditions."

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #044

Reference:

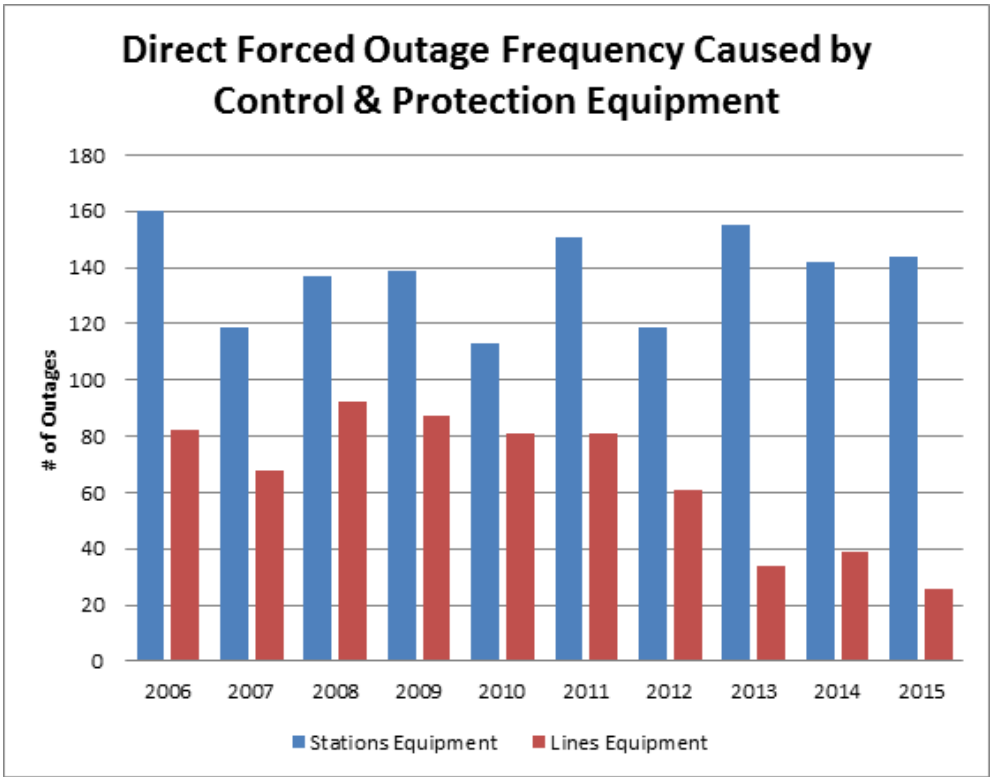
Exhibit B1 Tab 2 Schedule 6 Page 26 Figure 16

Interrogatory:

a) Please provide a chart to show the # of outages per year for Stations and Lines.

Response:

a)



# of Outages caused by Control & Protection Equipment										
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Station	160	119	137	139	113	151	119	155	142	144
Lines	82	68	92	87	81	81	61	34	39	26

Witness: Chong Kiat Ng

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #045

Reference:

Exhibit B1 Tab 2 Schedule 6 Page 26 Figure 16

Interrogatory:

Please provide all asset condition assessment reports prepared by a third party since 2010.

Response:

The only condition assessment report related to protections is PR-90-027 Accelerated Life Test – Programmable Auxiliary Logic Controller (PALC), which has been provided as Attachment 1 to Board Staff #46 (I-01-046-01).

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #046

Reference:

Exhibit B1 Tab 3 Schedule 1 Page 1

Interrogatory:

a) Please provide a Table that shows Hydro One's requested Budget $, Board Approved $ and Actual $ for the years 2010 to 2015 under the capital categories sustaining, development, operations, common corporate costs capital and Totals.

Response:

Please refer to table below for the data requested, for the four most recent historical years (2012 to 2015) in accordance with the Transmission Filing Guideline, in the following table:

Description	2012 Filed	2012 Appr.	2012 Actual	2013 Filed	2013 Appr.	2013 Actual	2014 Filed	2014 Appr.	2014 Actual	2015 Filed	2015 Appr.	2015 Actual
Sustaining	443.4	423.1	389.3	634.9	584.3	480.0	695.3	579.3	621.3	581.9	581.9	694.3
Development	456.8	448.8	329.4	348.0	277.8	171.7	306.2	195.6	131.6	209.7	209.7	166.0
Operations	57.4	56.4	15.2	47.5	38.5	17.7	56.5	38.5	28.4	38.4	38.4	15.6
Common Corporate Costs Capital	50.6	52.0	42.1	72.1	81.8	49.1	63.5	85.8	63.4	69.4	69.4	67.1
Total	**1,008.3**	**980.2**	**776.0**	**1,102.4**	**982.4**	**718.5**	**1,121.5**	**899.2**	**844.6**	**899.4**	**899.4**	**943.0**

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #047

Reference:

Exhibit B1 Tab 3 Schedule 1 Page 1

Interrogatory:

a) Please provide a Table that shows the forecast in-service additions compared to actuals for the years ears 2010 to 2015 and forecast for 2006 to 2018 under the categories sustaining, development, operations, common corporate costs capital and Totals.

Response:

Please refer to table below for the data requested, for the four most recent historical years (2012 to 2015) in accordance with the Transmission Filing Guideline, in the following table, and also in Exhibit D1, Tab 1, Schedule 2, Table 1 filed to the OEB on May 31, 2016.

Table 1: In-Service Capital Additions 2014 – 2018 ($ Millions)

	2012	2012	2013	2013	2014	2014	2015	2015	2016	2016	Test Years	
	ISA Actuals	OEB Approved	ISA Actuals	OEB Approved	ISA Actuals	OEB Approved	ISA Actuals	OEB Approved	Bridge Projected	OEB Approved	2017	2018
Sustaining	351.6	394.5	403.8	443.3	655.8	588.4	569.7	572.2	604.5	480.9	771.1	747.7
Development	793.8	1074.8	231.7	261.8	177.9	177.3	27.9	134.7	209.5	119.4	64.6	374.9
Operations	10.6	52.7	5.9	15.1	12.1	14.7	29.4	50.4	15.1	10.0	8.0	10.3
Common & Other	43.5	69.9	62.4	64	68.7	82.9	72.2	64.1	82.6	63.1	87.8	76.8
Total	**1199.5**	**1591.9**	**703.8**	**784.2**	**914.5**	**863.3**[1]	**699.1**	**821.3**	**911.7**	**673.3**	**931.4**	**1,209.7**

[1] The total amount represents the revised in-service capital additions in 2014, presented in the Settlement Agreement which was subsequently accepted by the OEB in EB-2014-0140.

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #048

Reference:

Exhibit B1 Tab 3 Schedule2 Page 3

Interrogatory:

a) Please discuss the impact on reliability if the 2016 Sustaining Capital budget was maintained at 2015 and 2016 spending levels.

Response:

Refer to Staff IR 15 (d) and Exhibit B1, Tab 2, Schedule 2, Attachment 2, Page 23. Scenario 1 is similar to 2015 and 2016 spending levels with worsening reliability risk. With a worsening reliability risk, system reliability performance is expected to deteriorate which will negatively impact our customers.

Witness: Mike Penstone

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #049

Reference:

Exhibit B1 Tab 4 Schedule 1 Pages 2-5

Interrogatory:

a) Please complete the following table:

Capital Cost Drivers	**2010**	**2015**	**2016**	**2017**	**2018**
Materials					
Construction, Labour, Fleet & Equipment					
Contracts					
Engineering & Project Management					
Commissioning					
Interest Capitalization Rate					
Overhead Capitalization Rate					

Response:

a) There is no material difference in the percentages between the years 2012 and 2015. For the years 2016, 2017 & 2018 we do not forecast or plan at this level of detail/breakdown, however we do not anticipate any material differences in the percentage breakdown for the Capital Cost Drivers across these years.

Witness: Brad Bowness

Capital Cost Drivers	2012	2013	2014	2015
Materials	18%	22%	23%	23%
Construction, Labour, Fleet & Equipment	5%	7%	7%	5%
Contracts	14%	11%	11%	12%
Engineering & Project Management	28%	30%	28%	30%
Commissioning	18%	13%	15%	15%
Interest Capitalization Rate	5%	4%	3%	4%
Overhead Capitalization Rate	12%	13%	13%	11%

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #050

Reference:

Exhibit B1 Tab 4 Schedule 1 Page 11

Interrogatory:

Preamble: Hydro One set annual escalation rates of 2.3% for 2017 and 2.5% for 2018 and a maximum contingency rate of 10% of the project's estimate.

a) Please show how the annual escalation rates for 2017 and 2018 were derived.

b) Please provide the historical annual escalation rates for the years 2010 to 2016.

c) Please provide a Table that shows the forecast contingency rates (%) for the years 2010 to 2016 and the actual contingency rates (%) used.

Response:

a) The escalation rates are aligned with Statistics Canada historical inflation data for transmission projects. Escalation on labour is based on rate tables that are determined by adjustments in payroll burden as per each respective labour component's collective agreement.

b) For the years 2010 to 2014, the escalation rate used was consistently set at 3% for Construction labour and 5% for all other estimate segments (i.e. Project Management, Engineering, Commissioning, Customer Operations, and Procurement). Beginning in 2015, Hydro One identified a more applicable rate of 2.5% that reflects Statistics Canada inflation data for transmission projects and these rates are more in line with rates used by other utilities.

c) Hydro One does not currently allocate or manage contingency at a portfolio level and therefore does not have the information collected in this manner. A recommendation from Navigant was to manage the contingency budgets at the portfolio/corporate level and Hydro One is investigating how best to implement this recommendation. The study is provided in Hydro One's application as Attachment 1 to Exhibit B2, Tab 2, Schedule 1.

Witness: Brad Bowness

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #051

Reference:

Exhibit B1 Tab 4 Schedule 1 Page 12

Interrogatory:

Preamble: Hydro One indicates the portion of the engineering portfolio completed externally has grown from 14% in 2012 to roughly 25% in 2015.

a) Please provide Hydro One's assumptions in this application regarding the % of the engineering portfolio completed externally for 2017 and 2018.

b) Please provide the ratio of fully burdened external labour to fully burdened internal labour for the years 2010 to 2018.

Response:

a) Hydro One plans to complete 43% and 39% for 2017 and 2018 respectively of the engineering portfolio through contracted external engineering firms.

b) The following table provides the ratio of fully burdened external labour to fully burdened internal labour for the years 2012 through 2018.

2012	2013	2014	2015	2016	2017	2018
66%	65%	66%	67%	62%	60%	61%

Witness: Brad Bowness

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #052

Reference:

Exhibit B1 Tab 4 Schedule 1 Pages 15 to 16

Interrogatory:

a) Please provide the portion of the total capital plan completed externally compared to internally for the years 2010 to 2018.

b) Please provide Hydro One's assumptions in the budget for 2017 and 2018 regarding the % of work undertaken by internal resources.

c) Please provide the % of work contracted out on a fixed-price basis for the years 2015 to 2018.

d) Please provide the % of line refurbishment capital work that will be done by external resources in 2017 and 2018 compared to 2015.

Response:

a) The chart below represents total contracted costs for 2012 – 2016.

2012	2013	2014	2015	2016	2017	2018
12%	13%	11%	11%	11%	14-18%*	16-20%*

*2017/2018 values are based on assumptions and not actual contract awards. They are subject to the execution model (ePC, PC, C, etc.) and market response.

b) Hydro One's assumption is that 70-80% of the work program will be completed by internal resources. In Construction Services our resource pool is provided through casual trades. The expectation is that the internal resource pool will remain flat at current levels and the majority of the increased work program will be constructed using external resources.

c) Hydro One's present contracting model to date has been "fixed price". Other contracting models are currently being explored to determine if this will result in increased cost efficiencies for rate payers.

Witness: Brad Bowness

d) In 2015 the entire lines sustainment work program was accomplished using internal resources (casual trades BTU and Provincial Lines PWU staff). In 2017/2018 10-15% of the lines refurbishment work program is expected to be outsourced. For the work executed by Provincial Lines 70% of the work is performed by full time PWU staff. The remaining 30% is augmented through use of the PWU Hiring Hall. If the PWU Hiring Hall is unable to provide adequate resources, Hydro One would then explore Purchased Services Agreement with the PWU in order utilize external contractors.

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #053

Reference:

Exhibit B1 Tab 4 Schedule 1 Page 17

Interrogatory:

a) Please provide the ratio of project estimates to project actuals for the years 2010 to 2015.

Response:

a)

	2012	**2013**	**2104**	**2015**
Ratio of Project Estimate to Project Actuals	5.8%	-7.1%	-13.8%*	-5.4%

*7.8% of the overall ratio was attributed to a single project to replace a large underground cable in the Greater Toronto Area. The project variance of -46% was a result of the contract award being significantly less than estimated. Removing this anomaly for 2014 would reduce the ratio to -6.0%.

Hydro One also has initiatives underway to improve the alignment between the estimate and actual by aligning the work/cost breakdown structures. For more information on the improvement initiatives please see Exhibit B1, Tab 4, Schedule 1.

Witness: Brad Bowness

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #054

Reference:

Exhibit B2 Tab 1 Schedule 1 Page 8

Interrogatory:

a) Please provide a list of the Tier 2 and Tier 3 metrics where historical data is not available.
b) Please provide a list of the Tier 2 and Tier 3 metrics that have not been previously measured.

Response:

a) Historical Data not Available

% of outages cancelled
Planned outages per Delivery Point
Stations Unavailability
% of Forced outages caused by equipment type
Sum of discounts and savings from strategic sourcing ($)
Number of transformers replaced versus plan
Number of breakers replaced versus plan
Cost per 115kV Tower Coated ($/tower)
Cost per 230kV Tower Coated ($/tower)

b) Not Previously Measured

% of budgeted work completed on or ahead of schedule
Number of transformers replaced versus plan
Number of breakers replaced versus plan
ECS Capital Expenditures/Project Management FTE
Engineering Costs/ECS Capital
ECS CapEx/Construction FTE
Facilities & Real Estate value realization (Ratio of facility savings and revenues to real estate operations cost)
Sum of revenues and savings from real estate initiatives ($)
Cost per 115kV Tower Coated ($/tower)
Cost per 230kV Tower Coated ($/tower)
Cost per Transmission Cable Locate ($/locate, network operating only)
Lines RCE
Stations RCE

Witness: Michael Vels

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #055

Reference:

Exhibit B2 Tab 1 Schedule 1 Page 9

Interrogatory:

a) Please provide the ratio of total unplanned capital work to total planned work for the years 2010 to 2015 and the forecast for 2016.

Response:

	2012	**2013**	**2014**	2015	2016
Total Unplanned Tx Capital Work / Total Planned Tx Capital Work	4%	2%	2%	3%	2%

Witness: Michael Vels

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #056

Reference:

Exhibit B2 Tab 1 Schedule 1 Page 18 Table 3

Interrogatory:

a) Please provide the $/tower coated for the years 2012 to 2015.

Response:

Steel Structure Portfolio		**Historic**			**Bridge**	**Test**	
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
$/tower coated ($K)	7.0	24.3	42.2	15.3	19.1	34.0	34.0

The unit cost for structure coating depends on the type of structure, circuit configuration and access. For example, the cost for coating a double-circuit 230kV structure is $43k per structure, while a single-circuit 115kV structure is $20k per structure. The $34k per structure in test years is based on the types of structures identified for recoating.

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #057

Reference:

Exhibit B2 Tab 1 Schedule 1 Pages 19 to 21

Interrogatory:

Preamble: Hydro One that its' RCE metric uses a three year average to mitigate the effects of an abnormal number of unplanned outages due to weather related incidents.

a) Please recast Table 4, Figure 5, Figure 6 excluding unplanned outages due to weather related incidents.

Response:

a) Please see requested table below. As illustrated, the overall trend for Lines & Forestry is significantly improved when weather related outages are removed. The Stations RCE trend remains the same as for most years weather related outages account for less than 1% of outages.

Lines & Forestry Services Transmission RCE Scorecard

	2009	2010	2011	2012	2013	2014	2015
Outages per Billion Dollars in Gross Assets	65.3	75.1	66.1	51.0	54.1	38.2	35.7
Gross Asset Value per Dollar of Maintenance Spend	86.0	98.4	94.8	109.4	100.3	92.9	101.7
Lines & Forestry Transmission RCE Score	**0.76**	**0.76**	**0.70**	**0.47**	**0.54**	**0.41**	**0.35**
3 year Average Lines & Forestry Transmission RCE Score			**0.74**	**0.63**	**0.56**	**0.47**	**0.43**

Station Services Services Transmission RCE Scorecard

	2009	2010	2011	2012	2013	2014	2015
Outages per Billion Dollars in Gross Assets	117.0	105.7	103.9	85.6	98.0	87.7	80.8
Gross Asset Value per Dollar of Maintenance Spend	42.6	47.2	46.0	58.2	56.9	62.3	66.8
Stations Transmission RCE Score	**2.7**	**2.2**	**2.3**	**1.5**	**1.7**	**1.4**	**1.2**
3 year Average Stations Transmission RCE Score			**2.4**	**1.9**	**1.8**	**1.5**	**1.4**

Witness: Michael Vels

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #058

Reference:

Exhibit B2 Tab 1 Schedule 1 Pages 22

Interrogatory:

a) Please provide IT costs as a % of Net OM&A & Capital Expenditures for the years 2011 to 2015.

Response:

Please see the table below.

	Metric	2011	2012	2013	2014	2015
IT Costs	IT costs as % of Net OM&A & Capital Expenditures	7.2%	7.6%	7.6%	6.6%	5.5%

Please note some IT OM&A costs were included within the Administrative Costs metric referenced in Exhibit B2, Tab1, Schedule 1, Table 5.

Witness: Gary Schneider

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #059

Reference:

Exhibit B2 Tab 1 Schedule 1 Pages 23

Interrogatory:

a) Please provide the ratio of unplanned work to planned work for Lines for the years 2011 to 2015.

Response:

Description		**Historic Years**			
	2011	**2012**	**2013**	**2014**	**2015**
Overhead Lines planned capital work ($M)	56.6	57.3	83.8	110.7	116.2
Overhead Lines unplanned capital work ($M)	12.9	8.0	8.2	8.7	8.8
Ratio	23%	14%	10%	8%	8%

Witness: Chong Kiat Ng

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #060

Reference:

Exhibit B2 Tab 1 Schedule 1 Attachment 1 Page 2

Interrogatory:

a) Please confirm the System Reliability data in the Scorecard includes Major Event Days.

Response:

a) "Major Event Days" concept is not used in transmission reliability metrics. The "System Unavailability (%)" includes all events. All the other metrics in the "System Reliability" group in the table include all events except one extreme event which is July 8, 2013 Greater Toronto Area (GTA) flood event. The GTA flood is discussed in Exhibit B1, Tab 1, Schedule 3, page 22 of 29.

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #061

Reference:

B2/1/1 Section 9.0

Interrogatory:

a) Is Hydro One aware of other transmitters using RCE as a reliability and cost efficiency measure, or is it unique to Hydro One?

b) If RCE is not unique to Hydro One, does Hydro One possess reports or other information indicating the performance of how other transmitters, especially those participating in the Navigant report?

c) If the answer to (b) is yes, please provide whatever information Hydro One possesses regarding the RCE performance of other utilities?

Response:

a) Through Hydro One's investigation of several other transmissions applications from across North America, no other transmitters were found to be utilizing this metric.

b) Hydro One does not have any reports or other information indicating the performance of other transmitters with regard to an RCE score. The RCE metric was not included in the Navigant report.

c) Please see response given to part b).

Witness: Michael Vels

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #062

Reference:

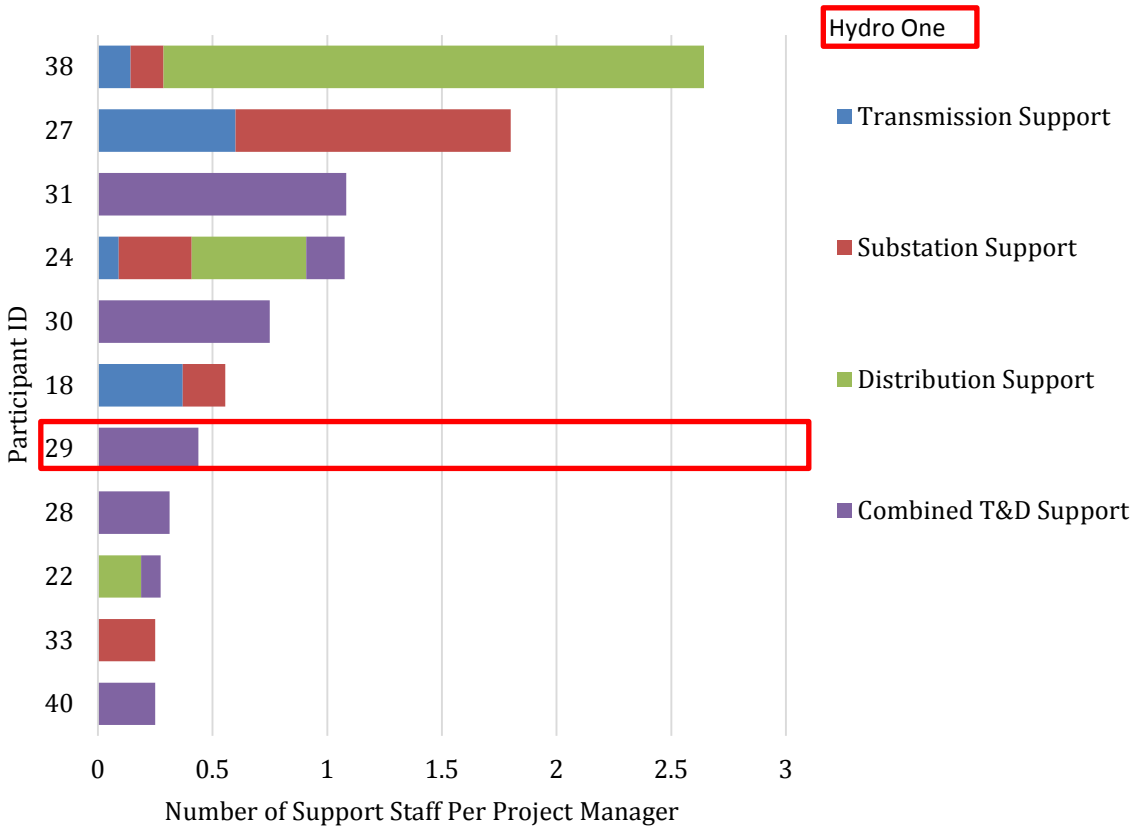
B2/2/1 Attachment 1

Interrogatory:

a) On page 20, both figures 23 and 24 have the same horizontal axis labels. Please correct.

Response:

a) The requested correction to Figure 24 has been completed.



Witness: Ben Grunfeld

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #063

Reference:

B2/2/1 Attachment 1

Interrogatory:

Preamble: On page 21, Fig 25 shows "actual spend as % of estimate". It is unclear what this means as a measure of Hydro One's project management performance.

a. Please identify which estimates were used to develop this chart. For example, were they initial budget estimates, study estimates, or release estimates?

b. Did the definition of "estimate" include modifications (variance approvals) obtained after projects commenced?

c. Does the number represented in Fig 25 represent a simple average of many projects, or a dollar weighted average (i.e., sum of estimates/sum of actuals), or some other calculation?

d. Did all transmitters in the study use the same calculation method and definitions?

e. Are customer connection projects included in this representation?

Response:

a) The estimates used to develop the chart were "release estimates".

b) "Estimate" is defined as the cost at the time the project started. It does not include modifications (variance approvals) obtained after a project is commenced.

c) The number represented in Figure 25 is the simple average of completed projects.

d) The benchmarking process used in the study incorporated a review of submitted data from all participants. A data response that appeared to be an outlier was verified with the submitter to assure that a common calculation methodology was used.

e) Yes. The calculation includes all projects completed during a particular year.

Witness: Ben Grunfeld

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #064

Reference:

B2/2/1 Attachment 1

Interrogatory:

Preamble: Hydro One has, in all its rate hearings, repeatedly suggested that sustainment CAPEX and OM&A needs are significantly driven by asset condition considerations and that furthermore, asset condition is substantially driven by age.

a) In this study, did Navigant compare the relative ages of the assets in the peer group?

Response:

a) Although a direct comparison of asset age was not performed, the study did include a look at the age of various assets in terms of the percent installed by decade.

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #065

Reference:

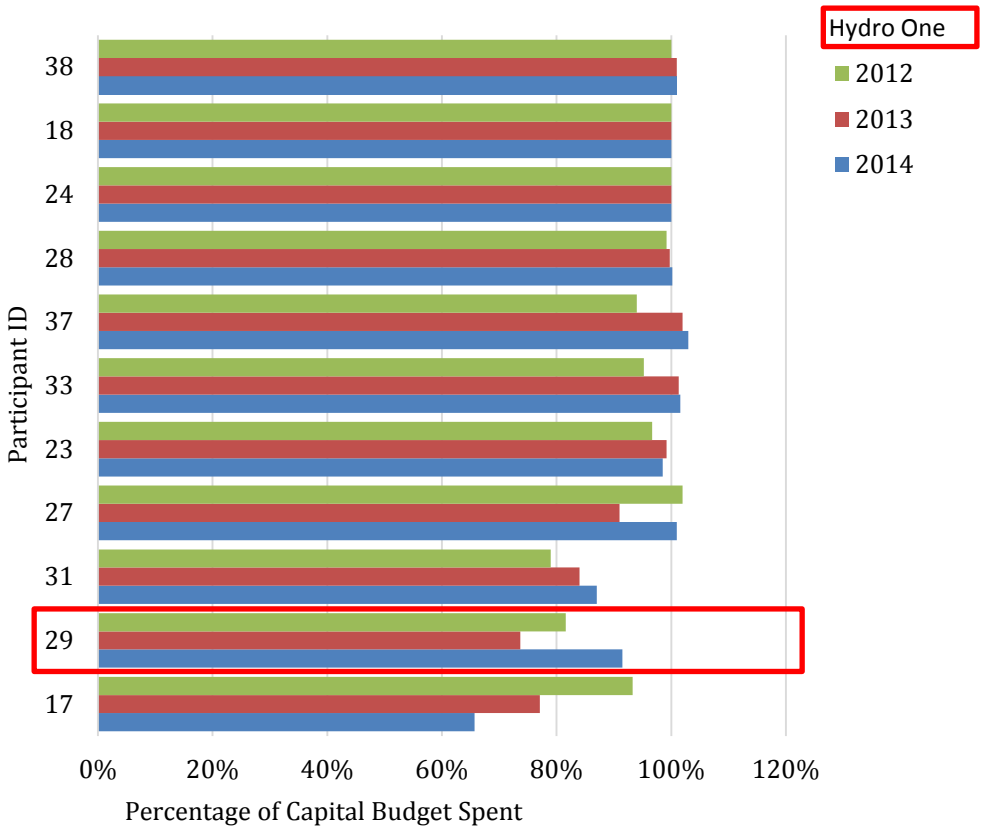
B2/2/1 Attachment 1

Interrogatory:

a) For Fig 27 on page 22, the label on the horizontal axis seems unrelated to the title. Please explain or correct.

Response:

a) The requested correction to Figure 27 has been completed.



Witness: Ben Grunfeld

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #066

Reference:

Exhibit C1, Tab 4, Schedule 1

Interrogatory:

a) Please provide a table that shows Hydro One's budgeted overtime $ compared to actual $ spent for the years 2010 to 2016.

b) Please provide Hydro One's overtime policy.

c) Please confirm Hydro One's overtime policies reflect those of the Province.

Response:

a) Overtime dollars are incorporated into the standard labour rates. The overtime dollars used in the standard labour rates reflect the historical overtime spend. Therefore a table cannot be provided.

b) Terms and Conditions related to overtime are governed by collective agreements and the Employment Standards Act. In addition, there are internal processes and reporting that enables managers to effectively use and monitor overtime usage.

c) Any policies regarding overtime within the Provincial Government are not applicable to Hydro One.

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #067

Reference:

Exhibit C1, Tab 3, Schedule 3

Interrogatory:

a) Please provide Hydro One's vacancy rate for the years 2010 to 2016.

b) Please provide the vacancy rate assumptions for 2017 and 2018.

Response:

a) The "vacancy rate" is a Human Resources metric used to determine the ratio of number of open vacancies to number of positions in an organization. This is not a metric that Hydro One tracks primarily because Hydro One does not experience difficulty in filling the majority of its positions.

b) See response to (a).

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #068

Reference:

Exhibit E1/3/1 Section 4.1.1 Hydro One's Weather Correction Methodology

Interrogatory:

a) Please confirm that the weather data used to generate Fig 3 and Fig 4 is the same as provided by Environment Canada for the weather station it identifies as "Toronto Intl A".

b) With respect to Fig 4, is it correct to assume that a colder minimum average daily temperature would normally suggest an increase in peak monthly demand during the winter months?

c) Would it be reasonable to assume that the minimum average daily temperature and the maximum average daily temperature for a given year would normally be established by the end of August in that year? If not, please provide information on any years when that has not been the case.

Response:

a) This is confirmed.

b) If all other things remained the same (such as the day, CDM, demand shifting, other weather conditions, etc.), it can be assumed that a lower temperature during winter would yield a higher peak load.

c) Normally, the minimum temperature is established by the end of August. Since 1985, exceptions to this general statement include the following years: 1989, 1993, 1998, and 2002. Similarly, the maximum temperature is normally established by the end of August. Exceptions to this general statement include years 2000 and 2015.

Witness: Bijan Alagheband

Association of Major Power Consumers in Ontario (AMPCO)
INTERROGATORY #069

Reference:

E1/3/1/Section 6 Variability of Hydro One's Load Forecasts

Interrogatory:

a) Please provide a version of Table 6, but with non – weather corrected actual demand.

Response:

a) Please see below a version of Table 6, but with non-weather-corrected actual demand.

Table 6
Historical Board Approved Forecasts
vs. Historical Actual

	Difference from Actual (%) *					
Type of Connection	EB-2006-0501 Forecast	EB-2008-0272 Forecast	EB-2010-0002 Forecast	EB-2012-0031 Forecast	EB-2014-0140 Forecast	**Average**
Network	-4.18	-1.43	-4.00	-5.16	-0.71	**-3.10**
Line	-0.71	0.79	-0.56	-4.21	-1.09	**-1.15**
Transformation	-1.02	0.16	-0.73	-3.77	-0.69	**-1.21**
Average	**-1.97**	**-0.16**	**-1.76**	**-4.38**	**-0.83**	**-1.82**
One Standard Deviation (+/-) **	3.34	3.34	3.34	3.34	3.14	

* A negative (positive) variance shows that the forecast was below (above) actual.
** Reflects expected deviation of forecast from actual based on historical variations.
For EB-2006-0501, EB-2008-0272, EB-2010-0002, and EB-2012-0031 forecasts 3-year standard deviation is shown.
For EB-2014-0140 forecast, only two years of actual (2014 and 2015) were available for comparison with forecast, therefore 2-year standard deviation is presented, which is naturally smaller compared to 3-year standard deviation as the forecast horizon is shorter. On the average, forecasts are within one standard deviation.