ONTARIO POWER GENERATION

Internal Audit

Darlington Nuclear Refurbishment ("DNR") Quality Oversight Audit

September 29, 2017

Report Rating: **Requires Improvement**

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1.0 EXECUTIVE SUMMARY

1.1 Report Rating and Summary of Findings

Report Rating: **Requires Improvement**

No.	Finding	Risk Type	Risk Rating[1]		
			High	Moderate	Low
1	The quality oversight planning framework may not achieve coverage objectives.	Operational	X		
2	Execution and reporting of field quality surveillance activities are inconsistent across quality oversight teams.	Operational		X	
3	Vendor Non-Conformance Reports ("NCR"s) were not consistently monitored.	Operational		X	
Total		**3**	**1**	**2**	**-**

1.2 Background

Following planning and design, Ontario Power Generation ("OPG") moved into the execution phase on the Darlington Nuclear Refurbishment ("DNR") project as of October 2016. A critical component of a successful refurbishment is that effective and efficient quality management processes are implemented that help control human performance, engineering, materials, field installations and Vendor/Contractor performance to meet quality requirements.

OPG's Darlington Refurbishment Program Quality Plan (NK38-NR-PLAN-09701-10001) aims to outline continuous quality surveillance that will be conducted on a sample basis to address the quality and regulatory requirements. The project's prime contractors have first line accountability for quality with OPG having an oversight role over the contractors' quality programs. OPG is positioned as the integrator and retained project management and design authority for the DNR project. The structure of the DNR Quality Oversight Lines of Defense framework as identified in the audit is presented in Appendix A.

This is a risk based audit identified in Internal Audit's ("IA") 2017 Strategic Audit Plan, selected given the significant focus on quality management and its impact on the DNR project schedule.

1.3 Objective and Scope

The objective of this audit is to review the design and operating effectiveness of OPG's activities around quality management for the DNR project. This will include reviewing processes and controls for the Unit 2 Program Quality Plan and project level quality management plans, as well as the effectiveness of quality measures followed by procurement, inventory management and equipment handling teams.

[1] Please refer to Appendix D for risk rating definitions

In order to achieve the audit objective, we had reviewed the process and tested, on a sample basis to:

A. Quality Management Framework and Governance

- Validate the design and operating effectiveness of:
  - Interfaces with vendor quality teams, third party quality assurance providers, and other OPG groups performing activities over quality to ensure there are no overall gaps in quality oversight;
  - Quality frameworks and standardized documentation are utilized to analyze disciplines (example Welding, Civil, Electrical etc.);
  - Non-conformance Corrective Action Report ("NCAR") / Notice to correct ("NTC") process (initiation, review, approvals and completion);
  - Field surveillance cadence, the sampling methodology for selected disciplines, reporting activities and trend management;
  - Feedback loops from Quality Management ("QM") reviews and outcomes to key stakeholders (i.e. Supply Chain for the Approved Suppliers List qualification process) in order to enhance processes, contract terms and conditions etc.;
  - Contractual Quality Assurance ("QA")/Quality Control ("QC") parameters, milestone based testing and field verification protocols; and
- Reporting cadence and quality of reporting (i.e. KPIs).

B. Contracts Management

- Assess whether confirmation of scope and quality requirements are formally documented in vendor contracts; and
- Perform a gap analysis on the interface between the vendor's contractual QA/QC requirements and OPG's DNR Program Quality plan.

C. Procurement and Inventory Management

- Assess the functional support provided by the Quality Management team and the design effectiveness of QM protocols followed by procurement and supply chain related to:
  - QM protocols over Factory Acceptance Testing ("FAT");
  - Application of protocols over inbound materials handling;
  - QM activities over materials/equipment preservation protocols (which ensure items are not damaged); and
  - Protocols over QM of inventory issued for construction, if applicable.

D. Document Management

- Assess protocols used by the QM team to capture NCARs, quality issues, corrective actions, testing outputs, commissioning outputs and close-out documentation (i.e. Operations and maintenance manuals and protocols, warranties, as-builts, etc.,); and
- Evaluate the document management systems used by the QM team and integration of data from field to the Unit 2 program.

E. Commissioning and Return to Service

- Assess application of QM protocols for pre-operational verification testing / pre-commissioning, commissioning and handover to operations; and
- Assess the process and controls for managing punch-lists (i.e. work not conforming to contract specifications) and protocols for deficiency management.

F. Fraud Risk Considerations

• Assess whether:
  ▪ Quality assurance personnel are inputting incorrect and/or false information;
  ▪ Vendors are providing inaccurate reports;
  ▪ Unauthorized materials are used;
  ▪ Unqualified personnel are performing quality tasks; and
• Means and methods not confirming to project and regulatory standards.

Scope Period: The scope included activities associated with the DNR project from August 1, 2016 to June 30, 2017, and may have included some precursor activities from prior periods.

1.4 Conclusion

Our review identified some issues in quality oversight planning, execution and reporting which may prevent OPG from achieving its quality objectives. Planned surveillances were not always completed and monitoring of vendor quality corrective actions should be improved.

Positive Observations

- The quality oversight framework has been evolving with the project moving from Segments 1 and 2 to Segments 3 and 4 which are significantly more complex. Quality oversight is now focusing on Restart Control Hold Point ("RCHP") and Integrated Implementation Plan ("IIP") vertical system slices which are critical for Return to Service and also focusing on critical horizontal system based activities.

- There are well-defined procedures and governance documentation in place, and staff performing quality surveillance and oversight have extensive OPG and industry experience.

Key Findings & Recommendations

- Actual field surveillance activities deviated from planned surveillances. For example, QM would identify 9 projects for surveillance, of which the Field Surveillance team only selected 4 for execution but only 2 surveillances were performed. We noted that surveillance activities are planned on a one week basis and activities are not tied to the P6 schedule or resource loaded. Management should develop a unified quality surveillance plan through the DNR project lifecycle with associated accountabilities and activities defined across the various oversight groups for clarity on coverage.

- Surveillance teams are not always provided with updated Construction Work Packages ("CWPs") or Inspection Test Plans ("ITPs") prior to the surveillance activity to facilitate sufficient planning. There are also no standardized quality surveillance deliverables nor a single repository to log surveillance results and quality issues across quality oversight teams. Management should reinforce requirements and develop standardized deliverables for surveillance activities.

- Until recently, DNR did not consistently obtain the vendors' Non-Conformance Reports ("NCRs"). There are also long outstanding (> 6 months) Non Conformation and Corrective Actions Requests ("NCARs"). Management should establish a process to monitor vendor NCRs and NCARs for timely completion of actions and assess their impact on the DNR project.

The findings noted in this report have been reviewed with management and they have committed to specific action plans. Please refer to Section 2.0 for specific details of the above findings along with the associated risk impact, audit recommendations and management action plans.

2.0 DETAILED AUDIT FINDINGS

Internal Audit identified the following detailed findings and recommendations which have been risk-rated based on the definitions outlined in Appendix D.

1. The quality oversight planning framework may not achieve coverage objectives.	**High**

QM determines the level of surveillance required over priority[2] systems and parts to assess compliance with design specifications and regulatory requirements. However, we noted issues in QM surveillance planning as follows:

- Each week, QM Planning develops a list of critical quality project tasks for surveillance. However, the QM Field Surveillance group will reduce this list based primarily on limitations to site access or resources.
    - In the week of September 12, 2017, QM Planning identified 9 projects for surveillance, of which only 4 were selected by QM Field Surveillance. Further, only 2 surveillances were performed, resulting in coverage of ~22% of the original list; and
    - During the period July 25, 2017 to September 12, 2017, the QM field surveillance team completion of planned surveillances ranged from 20%-75%. See Appendix B for further details.
- QM field surveillance guide (NK38-GUID-09701-10038) requires a planning window of 6-12 months with tie in to the P6 schedule. QM teams did not have a 6-12 month look-ahead that tied into the P6 schedule. Surveillance activities are planned and resourced on a weekly basis but look-aheads were not planned in accordance with the guide. For example, QM had a shorter 3- month look-ahead that also did not consider resource loading (i.e. technical or trade resources). Additionally for QM defined critical systems/parts, lifecycle-based plans were only prepared for three programs (Breathing air, valve rehabilitation and liquid release valves);
- Through a risk-graded approach, Quality Management ("QM") determined 8,199 parts that were considered priority parts for OPG quality surveillance to be performed by Procurement Quality Oversight ("PQO"). PQO then used their own risk graded approach to eliminate possible redundancies, reducing the QM priority parts list to 387 (4.7%) parts for surveillance but IA was not able to obtain evidence that the reductions were validated with the QM team.
- In July 2017, surveillance tracking of the parts which had incomplete oversight remaining from the original 387 parts was transferred from Excel to activity based reporting in the RMO system which resulted in reduced visibility to the parts surveyed to date; and
- Roles and responsibilities for quality oversight for certain functions have not been formally defined. Construction Work Packages ("CWP"s), Inspection Test Plans ("ITP"s), Construction Closeout Documents ("CCD"s) and Available For Service ("AFS") documentation is reviewed by multiple parties including QM, Quality Engineering and Construction Oversight. While it may be appropriate to have multiple levels of oversight, gaps or duplication of effort may result if accountabilities are not clearly defined and communicated.

Potential Cause & Impact

Potential Causes:

- Staff may be unaware of the look-ahead period in the field surveillance guide;
- Restrictions to access the construction site and availability of staff resulted in lower field coverage;
- There were staffing changes in the oversight teams; and
- QM works with peer groups to prioritise and focus quality oversight activities but the accountability to oversee the entire quality oversight program for coverage and consistency has not be clearly identified.

[2] Priority systems and parts are those defined by the QM team based on NK-CORR-09701-0598247 and and NK38-CORR-0970-1-0609103

Impacts:
Lack of a centrally coordinated and executed QM plan across the project can result in inadequate oversight coverage across critical tasks that may result in:

- Unexpected costs and schedule delays may be incurred if defects are not detected;
- Less timely information to management on quality issues with lower surveillance coverage;
- Lower productivity if there are overlaps in oversight activities; and
- An inability to secure skilled resources for field quality surveillances without longer look-aheads.

Recommendations

Management should:

- Develop a unified mandate and quality surveillance plan that identifies critical areas of focus using a consistent graded approach for oversight functions based on priority systems and parts;
  - Clearly communicate the plan to project stakeholders to ensure appropriate participation and support while QA/QC programs are being carried out by vendors;
- Ensure access to the field is secured well in advance of surveillance activities with escalation protocols if access is limited; and
- Establish minimum coverage targets for quality field and parts / systems surveillances that are reported to quality and senior management on a weekly and monthly basis respectively.

Management Action Plan

- QM guide will be updated to align with the QM Functional Management plan requirement for a three month look ahead;
- Based on priority systems and parts, the QM team will develop a master schedule based on the target completion dates for RCHP 1-9 with a three month look ahead QM surveillance plan using a well-defined risk based sampling approach covering the entire project;
- The schedule will be shared with stakeholders who need to be engaged or provide support for quality oversight activities to facilitate alignment of resources and escalation protocols will be established for any challenges in obtaining field access for surveillance activities; and
- Performance of field surveillance will be monitored and reported to management at the monthly Project Quality Oversight Meetings to confirm achievement of plans and identification of any issues.

Action Owner: Imtiaz Malek, Director Nuclear Oversight Quality Maintenance
Target Completion Date: December 15, 2017

2. The execution and reporting of field quality surveillance activities are inconsistent across quality oversight teams.	**Moderate**

NK38-GUID-09701-10038 Quality Surveillance Guide provides guidance on the preparation and methodology for walk-throughs, surveillance steps/protocols, checklists and reporting. However, we observed different practices in executing and reporting quality field surveillance activities as follows:

- The QM field surveillance team was not always provided with required documentation in advance to plan their walk-throughs (i.e. updated CWPs, ITPs or work plans);
- Formal field surveillance plans and checklists are not prepared prior to the walk-throughs as the QM field surveillance personnel are relying on their individual knowledge and experience;
- There was a lack of standardized quality surveillance templates and deliverables across QM, Quality Engineering, Procurement Quality and Construction Oversight e.g. only some reports have follow-up actions, Corrective Action Report references and recommendations; and
- There is also no single repository to log quality issues. Issues are logged through the RMO system, Station Condition Records ("SCR"s) and Excel tracking logs. Multiple repositories and reporting formats would impede comparisons and development of trends.

Since Sept. 21, 2017, the QM Surveillance group was disbanded and QM has taken on a planning role, relying on other DNR oversight groups to perform surveillance work on their behalf. This is being defined as part of the RCHP/IIP based lifecycle quality management model for Segments 3 and 4.

Potential Cause & Impact

Potential Causes:

- QM works with peer groups to prioritise and focus quality oversight activities but does not have accountability to oversee the entire quality oversight program for coverage and consistency;
- Field surveillance individuals rely heavily on their knowledge and experience to conduct surveillances and may not have considered formally their field surveillance steps; and
- There is no standardization of reporting for quality surveillance activities or issues, and no central repository or consolidated reporting.

Impacts:

- Limited surveillance can result in some critical focus areas not being reviewed by QM;
- Lack of the ability to perform detailed reviews of CWP's and WP's prior to scheduling a quality surveillance activity may result in missed opportunities to survey high risk areas; and
- The lack of a structured approach to field surveillance can result in an incomplete surveillance being performed with potential critical tasks /activities being missed.

Recommendations

- Establish a centralized function that will oversee consistent execution of field surveillance activities;
- Train QM staff on the use of the QM surveillance guide (NK38-GUID-09701-10038) to ensure consistent application of the guidelines and requirements when performing field surveillance; and
- Consolidate and maintain an independent single QM surveillance findings log which will provide trends and insights generated through a single repository.

Management Action Plan
QM field surveillance program has been transferred to Construction Oversight in line with division of responsibilities to ensure front line field personnel are providing this surveillance function. QM will have two staff assigned to support specialty areas of interest to QM. The surveillance activities will be defined in the Segments 3 & 4 plan which will specify specific requirements for the execution and reporting of surveillances. Results of surveillance activities will be consolidated and shared in the monthly Project Quality Oversight meetings. **Action Owner:** Imtiaz Malek, Director Nuclear Oversight, Quality Maintenance **Target Completion Date:** January 31, 2018

3. Vendor Non-Conformance Reports were not consistently monitored.	Moderate

The Engineering Procurement Construction ("EPC") vendor is the first line of defense in quality (See Figure 1 – DNR Quality Oversight Lines of Defense in Appendix A). Vendors are required to develop and execute their quality program compliant with OPG and CSA N-286 requirements.

Reliance is placed on the vendors' quality programs and OPG performs quality surveillances on a sample basis to assess the effectiveness of the programs. However, we noted that in some cases, OPG does not have visibility to corrective actions taken by the vendor on quality gaps which may impede the effectiveness of their quality program. The following observations were noted:

- Non Conformation and Corrective Actions Requests ("NCAR"s) are issued by OPG's Supply Chain Quality Services ("SCQS") to notify vendors of a non-conformance identified in the vendors' quality program. As at August 22, 2017 we noted 12 NCARs open for more than six months which should be reviewed by QM to assess for potential risks to the DNR program. Review of the 3 longest items noted that actions are completed and pending effectiveness review for closeout. See Appendix C for a list of the NCARs;
- Refurbishment Management Systems ("MSO") monitors vendors' Corrective Actions Reports ("CAR"s) which are expected to capture the more significant issues. However, vendors also use Non-Conformance Reports ("NCR"s) for field construction issues. [redacted]. Until recently, DNR QM oversight groups did not receive NCR reports from vendors. The vendors now provide NCR logs but these reports are not consistent and lack important information such as target completion dates. Due to the lack of standardisation of the NCR logs, reporting on certain performance metrics and trending may not be possible; and
- A formal process has not been established by DNR to monitor vendor resolution of NCR quality non-conformances. We also observed there is no evidence of quality issues flowing from Vendor NCRs into OPG's SCR/RMO databases for visibility and tracking.

Potential Cause & Impact

Potential Causes:

- Standardized reporting on vendor corrective actions and expectations on timelines to resolve quality gaps has not been developed by OPG nor communicated to vendors.

Impacts:

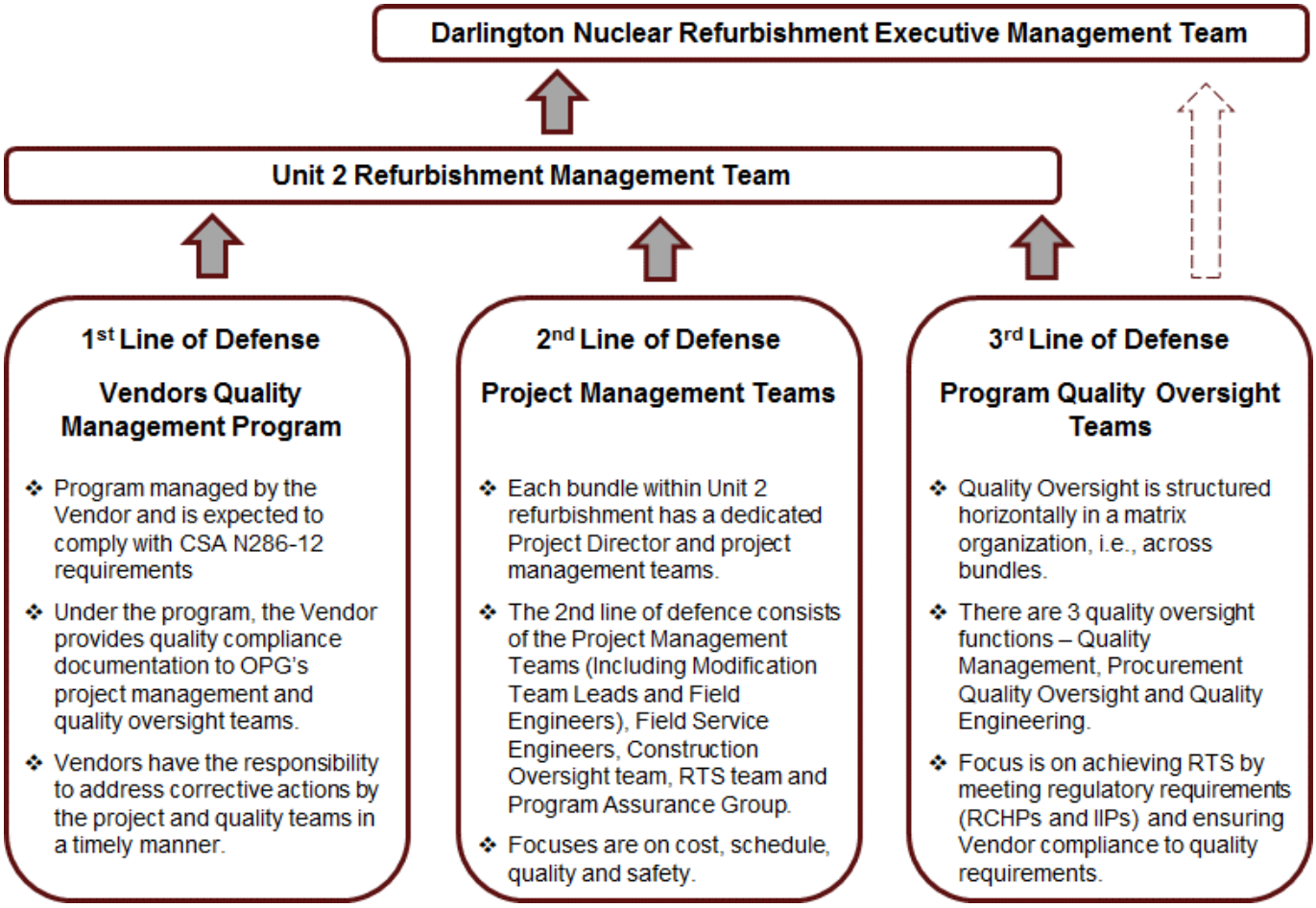
- The lack of visibility into the vendor corrective actions prevents OPG from understanding impacts to interdependent tasks;
- Delays in remediating quality gaps may impact the performance of the project; and
- Monitoring of performance metrics and trending may be hampered with non-standardized quality reporting.

Recommendations

- The DNR project team should establish a formalized process to align the vendor EPC NCR process to OPG's QM program and reporting requirements;
- QM should review aged open NCARs to assess risks to the DNR program; and
- Incorporate vendor NCR quality issues and trending into the monthly Project Quality Oversight meetings where information on NCARs, SCRs and CARS are reported by the other oversight functions like MSO and SCQS.

Management Action Plan
QM is now monitoring NCRs and NCARs and engaging Quality Engineering to ensure these are processed appropriately. Results will be incorporated in to the monthly Project Quality Oversight meetings. **Management Owner:** Imtiaz Malek, Director Nuclear Oversight, Quality Maintenance **Target Completion Date:** November 15, 2017

APPENDIX A – DNR Quality Oversight Lines of Defense



APPENDIX B – ACTUAL FIELD SURVEILLANCES COMPARED TO PLAN

Week of 2017	# of Projects by QM Planning	# Planned by Field Surveillance	# Projects Actually Surveyed by Field Surveillance	% Complete of Field Surveillance Plan	% Complete of QM Plan	Comments
7/25	12	6	3	50%	25%	Completed reviews were desktop reviews, 0% completed on field surveillance
8/1	12	5	1	20%	8%	Surveillance team had requested access for 5 packages and only received 1 package. The other CWPs were apparently not ready at that time.
8/8	12	2	1	50%	8%	Surveillance team had requested access for 2 packages and only received 1 package. The other CWPs were apparently not ready at that time.
8/15	12	5	2	40%	17%	No access provided for 3 packages
8/22	12	5	3	60%	25%	No access provided for 2 packages
9/5	10	4	3	75%	30%	No access provided for 1 package
9/12	9	4	2	50%	22%	For the 2 packages, in 1 no access was provided and for the other the work was completed by the time the project team responded to Field Surveillance

APPENDIX C – VENDOR NON-CONFORMANCES GREATER THAN 6 MONTHS

As at August 22, 2017

No.	AR #	NCAR #	Date NCAR Issued	NCAR Issue	Vendor	Days NCAR Open
1	28150597	40	20151026	Inspection & Test Plans	[redacted]	661
2	28150597	41	20160310	Operational Safety Focus	[redacted]	525
3	28150527	55	20161108	Oversight of Engineering Service Suppliers	[redacted]	282
4	28150527	56	20161108	Surveillance of Procurement Activities	[redacted]	282
5	28150527	57	20161108	Project Plans not Prepared	[redacted]	282
6	28150527	58	20161109	Conduct of Internal Audits	[redacted]	281
7	28150524	21	20161111	Design Verification Activities	[redacted]	279
8	28150524	22	20161111	M&TE Controls	[redacted]	279
9	28150524	25	20161111	Incoming Inspection / Inspection Status	[redacted]	279
10	28150524	26	20161111	External Audits	[redacted]	279
11	28150527	59	20161109	Lack of Qualified Resources for Oversight	[redacted]	281
12	28150494	6	20170119	Adverse Trend - Material Quarantine	[redacted]	210

APPENDIX D – RISK RATING DEFINITIONS FOR AUDIT FINDINGS

Ratings are derived through professional judgment by the audit team and discussion with management. The ratings for individual control findings are outlined below.

Rating	Definition
High Risk	The finding presents a risk that could potentially have severe/major impact on financial sustainability (≥$5M), operational excellence, project excellence, safety, environment and reliability, reputation, regulatory relationship, or compliance with laws and regulations.
Moderate Risk	The finding presents a risk that could potentially have a moderate impact on financial sustainability ($500K to <$5M), operational excellence, project excellence, safety, environment and reliability, reputation, regulatory relationship, or compliance with laws and regulations. If not remediated, this risk could escalate to high risk.
Low Risk	The finding could potentially have a minor impact on financial sustainability (<$500K), operational excellence, project excellence, safety, environment and reliability, reputation, regulatory relationship, or compliance with laws and regulations. Recurring "low risk" findings may be elevated to medium risk status.

OVERALL REPORT RATING SCALE

An overall report rating has been assigned as an indication of the overall design, existence and effectiveness of the components of the internal control structure that was subject to the internal audit. The internal audit rating should be considered in conjunction with the definitions noted above.

- *Effective:* control and risk management practices provide reasonable assurance that business process objectives will be achieved and may include minor improvements and/or opportunities for improvement.
- *Generally Effective*: control and risk management practices require more than minor but less than significant improvements to provide reasonable assurance that business process objectives will be achieved.
- *Requires Improvement*: control and risk management practices require significant improvements in high risk and/or core areas to provide reasonable assurance that business process objectives will be achieved.
- *Not Effective:* control and risk management practices are not designed and/or are not operating effectively.

APPENDIX E – PROCESS OWNER & DISTRIBUTION LIST

Dietmar Reiner
SVP, Nuclear Projects

Michael Allen
SVP Nuclear Refurbishment

Distribution List:

Jeff Lyash	President & Chief Executive Officer
Ken Hartwick	SVP Finance, Strategy, Risk and Chief Financial Officer
John Blazanin	VP Nuclear Finance
Neil Mitchell	VP Refurbishment Engineering
Bill Owens	VP Refurbishment Execution
Robby Sohi	Chief Supply Officer
Peter Simpson	Deputy Site VP
Adam Chiarandini	Director Enterprise Risk Management
Janice Ding	Director Internal Audit
Mark Knutson	Director Nuclear Oversight
Kendra Flagler	Acting Director Refurbishment Management & System Oversight
Imtiaz Malek	Director Nuclear Oversight, Quality Maintenance
Roy Martin	Project Director Project Execution Programs Strategy