



Knowledge Retention at Ontario Power Generation: Process and Results

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Ontario Power Generation (OPG): Context

OPG operates hydroelectric, thermal and nuclear generating facilities with a combined recent capacity of 19,000 MW (decreasing to about 13,600 MW with coal closure by year-end)

Regulated Nuclear facilities include:

- 4 x 875 MW CANDU PHWR Units at Darlington
- 4 x 515 MW CANDU PHWR Units at Pickering 5-8; 2 x 510 MW CANDU PHWR Units at Pickering 1, 4
- 2 Units in safe store at Pickering 2-3 plus Nuclear waste facilities and tritium removal facility

These facilities are of different designs/technology built over a 25-year period. (Historically, higher levels of internal Engineering support have been necessary compared to U.S. Plants – currently OPG has about 5,500 staff of which 970 are Nuclear Engineering.) The Pickering Units will be shutdown by 2020, Darlington will undergo life-extension outages starting in 2016, and New Build is in the planning stages (the Province will make the final if-and-when decision).

As a result of Business Transformation to a Centre-Led model, Nuclear Engineering staff levels are undergoing a planned reduction from >1,000 in 2010 to 882 by 2015. Correspondingly, OPG is transitioning to outsourcing much of our project work, using an engineer-procure-construct (EPC) model, to two primary vendor consortia under a master services agreement (MSA).

OPG is in a state of flux. These coincident, diverse situations strongly challenge Knowledge Management at OPG.





Knowledge Management at Ontario Power Generation

Background for Knowledge Management in OPG

OPG takes a very broad view of the scope of Knowledge Management (KM) including areas such as design basis management, configuration management, safe operating envelope, margin management, and integrated aging management, and has made the necessary investments.

Past KM activities at OPG include:

- a project for Design Basis Reconstitution of the System Design Requirements for a total of 128 safety-related systems at the OPG nuclear plants
- an IAEA Special Assist Mission to Darlington NPP on Nuclear Knowledge Management in 2007
- a project to rigorously establish the Safe Operating Envelope at the OPG nuclear plants
- participation at an International Conference on "Nuclear Knowledge Management in Nuclear Facilities" at IAEA Headquarters in Vienna in 2007
- participation in a Nuclear Utility Workshop on Knowledge Management in 2009
- a project to reverse engineer the design basis for legacy control software at Pickering.



Focus: Knowledge Retention at OPG

One aspect of Knowledge Management is staff **Knowledge Retention (KR)**. OPG has implemented a simple but effective KR process:

- Based on a previous TVA Model with refinements; benchmarked with Ginna NPP and with a Bulgarian NPP (Kozloduy)
- Focus is on critical positions where knowledge loss is the greatest threat:
 1. Identify and prioritize the specific knowledge and skills at risk.
 2. Develop concrete, actionable responses to mitigate the loss.
- Piloted first in one Engineering Division for several years, then extended to all of Engineering and then to all of OPG.



Knowledge Retention Process

Step 1: Conduct the Risk Assessment of Knowledge Loss on a Person by Person Basis (people-centric)

Tactfully identify the expected retirement/departure date of staff:

- Supervisor engineering work management review
- Manager/incumbent interviews

Score from 1 to 5

(with current or next year assigned the highest score)

X

Assess position/knowledge criticality based on importance, difficulty to replace, uniqueness, etc.

Score from 1 to 5

Focus on scores of 20 to 25 – for these, high priority action needed; however, sometimes a product score of 15 may warrant action.



Knowledge Retention Process



Records File Information: OPG Confidential - unless complete
Filed Locally/Departmentally N/C ORN-11167-00007
Retention - 5 years Risk and Criticality Assessment Form

Knowledge Retention - Computers and Control Design Department

Incumbent Name	Position	Assigned Retirement/Departure Date	Retention/Departure Factor	X	Position Risk Factor	=	Total Retention Factor
Joe	Manager	1/1/2009	4	4			16
Tony	Assistant Analyst	10/30/2010	3	3			9
Sam	Senior Technical Specialist	10/30/2009	1	5			10
Al	Senior Technical Specialist	10/30/2012	1	5			10
Wendy	Assistant Technical Engineer/Officer	10/30/2009	2	5			10
Jim	Senior Technical Engineer/Officer	4/30/2012	1	4			4
Debra	Senior Manager	3/1/2021	1	5			5
Bill	Senior Engineer	1/20/2002	3	4			20
Henry	Technical Engineer/Officer	10/20/2013	1	2			2
Jeff	Technical Engineer/Officer	10/11/2003	1	3			3
Christine	Assistant Technical Engineer/Officer	11/30/2024	1	2			2
Al	Assistant Technical Engineer/Officer	10/30/2013	1	2			2
Jim	Assistant Technical Engineer/Officer	11/2/2013	1	1			1
Mike	Senior Engineer	11/30/2014	1	1			1
Linda	Assistant Technical Engineer/Officer	10/30/2014	1	0			0
Paul	Senior Technical Engineer/Officer	10/30/2009	5	3			15

*Revised on 06/29/2012 (02:10:10) (SMB): Section For Engineering Knowledge Retention



Knowledge Retention Process

Step 2: Prepare Knowledge Retention Plan for High Risk People (Functions)

- For each individual, list the main areas of work activity
- For each area of work activity, assess:
 - The importance of the work activity
 - The rarity of the knowledge needed to perform the work activity
 - The difficulty in recovering the capability to perform that work activity if the capability disappears.

Step 3: Identify the roll-up of knowledge / skill loss areas (position or function centric)

- Supervisor engineering work management review
- Business Planning look-ahead
- Succession plan update
- Manager/Incumbent interviews

Results from Pilot:

- 250 Engineering staff assessed
- 30 high risk critical Knowledge Areas were identified and specific action plans were developed.

Knowledge Retention Plan Solution Groupings

Actions fall into several groupings:

- Mentor & Coach staff to transfer the knowledge
 - Includes new and existing, junior or experienced staff;
 - Involves OJT, rotations, acting in role prior to departure of retiring staff, formal external training
 - Distributing the knowledge of a single individual across several remaining staff
- Create Centres of Excellence by consolidating distributed expertise into a single unit (e.g. motors, thermal hydraulics)
- Hire experienced staff (when feasible) or train new graduate hires
- Buy the expertise from consultants or external design agencies
 - Work with other utilities to develop capability to support the industry
- Codification, documenting processes, lists of existing information and source documents, guides, technical bases, reverse engineering
 - Administrative Procedures and Guides
 - Design Basis Documents
 - Concept Mapping (for tacit knowledge)
- Engineer Out the requirement for the expertise (technology, organization)
- Create Knowledge Repositories (e.g. SharePoint KR sites)

Knowledge Retention Process

STEP 3: Knowledge Retention Plan

Position, Person (Name) & Date	Importance	Rarity	Difficulty	Recovery	Knowledge Retention Strategy	Role	Accountability	Status
AV (Area Development) (M. J. Smith)	3	3	3	3	100	100	100	Completed
AV (Area Development) (M. J. Smith)	3	3	3	3	100	100	100	Completed
AV (Area Development) (M. J. Smith)	3	3	3	3	100	100	100	Completed

For consistent notation with a Criticality Score of 43 or more - a Knowledge Retention task/ milestone should appear in the Knowledge Retention Plan.

Knowledge Retention Strategy: 100% = All knowledge captured; 75% = Most knowledge captured; 50% = Some knowledge captured; 25% = Limited knowledge captured.

Role: 100% = Role holder; 75% = Role holder with backup; 50% = Backup role holder; 25% = Backup role holder with backup.

Accountability: 100% = Role holder; 75% = Role holder with backup; 50% = Backup role holder; 25% = Backup role holder with backup.

Status: 100% = Completed; 75% = In Progress; 50% = Not Started; 25% = Not Started.

Original Process Guide for KR

ONTARIO POWER GENERATION

Classification: Internal Use Only
 N-GUIDE-001.00-100002
 N/A P-000

GUIDE FOR ENGINEERING KNOWLEDGE RETENTION

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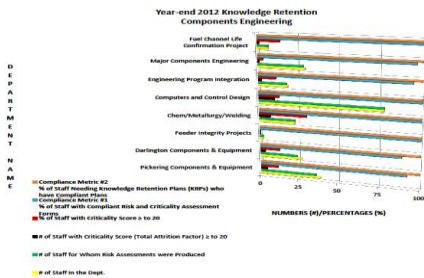
Resources in Place to Support the KR Process

- Corporate Human Resources has taken the Nuclear KR Guide and prepared a 37-page Tool-kit:
 - Overview of the KR process, the need, and accountabilities
 - Descriptions of each of the available solutions for Knowledge Retention Plans (KRPs)
- Corporate HR maintains a KM website
 - The KM Toolkit and the two forms
 - An "Introduction to KM" presentation
 - Key messages to Managers and staff
 - A KM Job Aid and Frequently-Asked-Questions
- SharePoint Knowledge Portals have been set-up
 - Structure is specific for how the organization does work
 - Needed as a place where staff currently expert at the work can capture the "how to" and "why" aspects for future use by others
 - Supported by a Plan to populate the knowledge repository.

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Roll-up of Results



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Recommendations for Improved Effectiveness

- Enforce more frequent updating of risk assessment tables and Knowledge Retention Plans (e.g. twice per year).
- Increase exposure for new grads to higher risk work – currently experience/knowledge gaps are compensated by senior staff.
- Place more emphasis on “Position” and “Departure” factors, and not just the “Retirement” factor.
- Solutions that are effective in the short-term (e.g. smart buying) need to be tracked to ensure that they remain effective (e.g. due to external capability decline or loss of internal capacity to “buy smart”).
- An oversight review of KRP progress and risk area mitigation should occur annually by Senior Management (inspect what you expect).
- Develop a reward component that recognizes knowledge transfer efforts by staff.
- Assess the effectiveness of Knowledge Retention Plans (KRPs) taken to completion (i.e. staff who have retired or departed), the steps taken to retain the required knowledge, and make recommendations for improved effectiveness.
- Utilize metrics to quantify false-positive and false-negative risk assessments and their impact and avoidance.

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Summary

The Knowledge Retention process at OPG comprises two parts:

1. **RISK ASSESSMENT** – Straightforward, using information readily available from existing business processes.
2. **KNOWLEDGE RETENTION PLANNING** – requires strategic thinking to best utilize scarce resources.

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