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THE PROFESSIONAL DEVELOPMENT CULTURE AND PERFORMANCE IMPROVEMENT

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ABSTRACT

The decline in performance of Canadian nuclear power plants has been widely analyzed and discussed at industry meetings. Many excellent performance improvement programs have been put in place to restore performance to an international standard of excellence. Most of these improvement programs focus on the management of processes and people. The purpose of this paper is to examine the role of professional conduct and professional development in strengthening and supporting performance improvement programs.

The nuclear industry has accepted global performance standards. 'World class' no longer means exceptional achievement – it is the expected industry norm. To build and maintain professional qualifications to international standards, requires a long-term commitment from employees, employers and the supporting institutions. Atlantic Nuclear's programs to address this challenge are discussed.

1. INTRODUCTION

The operating goal for a nuclear power plant is to produce electricity efficiently and safely at a high capacity factor from startup until its shutdown at the intended end of life. Since only a few plants have been successfully operated to their end of life, the management methods and engineering practices needed to achieve the operating goal are not generally established. In Canada, and elsewhere, some ageing plants have shown declining performance and degraded equipment requiring costly repairs or replacement. The owners are then faced with a premature closure of the plant or implementation of performance improvement programs to re-establish its financial viability. The improvements are directed to putting in place the programs for maintenance and operation that will ensure the operating goal is achieved.

One important element in the performance equation is the professionalism of the plant staff and their suppliers in the nuclear industry. This paper examines the role and implementation of a professional development culture in performance improvement. It is based on personal

experience and programs being put in place at Atlantic Nuclear.

The paper starts from the premise:

- A high standard of plant performance will be achieved if each individual performs their job, in all its aspects, with a high standard of professionalism.

The premise assumes the corporate institution is providing direction, resources and the framework within which the individual=s work is being done. An effective quality management system would be expected to ensure a high standard and quality of individual work. For example, the training requirement stated in ISO 9001 [Ref. 1] includes:

> *.....Personnel performing specific assigned tasks shall be qualified on the basis of appropriate education, training and/or experience as required.....*

Technical leadership comes from the professional staff and is not vested with management. Thus, the technical community must set the standards for professional performance. The challenge is to ensure that the technical staff are qualified throughout the life of the facility. This leads to the concept of continuous professional development which is discussed in Section 2.0.

The company is responsible for assigning qualified individuals to tasks. However, the employees are ultimately responsible for their own competence. The roles of the employee and employer are discussed in Section 3 along with the role of professional associations in supporting and certifying the level of competence.

To address the needs of both the employer and the employee requires a model of shared responsibility. Professional associations and educational institutions play a large role in supporting an individual=s professional development. Professional associations are quite variable in their offerings at the individual as opposed to the corporate level of investment in development. The move to task specific certifications creates an additional role for the professional associations in setting the qualification requirements.

A successful professional development program needs criteria for assessing success. Both self-assessment and independent assessment are needed for an effective program. In Section 4.0 the essential ingredients of assessment criteria are discussed.

To implement an effective professional development culture requires acceptance of a long term action plan by the employee and employer. Atlantic Nuclear is implementing a continuous professional development program as an extension of its quality management system. The program is based on the concepts developed in this paper and it is summarized in Section 5.0 as

an example that small companies can meet the requirements for continuing professional development.

2.0 PROFESSIONAL DEVELOPMENT AND PERFORMANCE IMPROVEMENT

The implementation of performance improvement programs emphasizes the management and conduct of work processes. While this is a necessary step in recovering a high level of plant performance, it is not sufficient. The high performance of the staff within the work processes is necessary as well. Each individual must be competent in their assigned tasks and they must maintain that competency throughout the life of the plant.

It is generally accepted that a plant ageing program is necessary to maintain production and safety margins. These programs address equipment and not the staff. There is an ageing of the plant staff as well – not in biological terms but in professional competence and performance. Two factors contribute to the ageing of the staff.

> **Technological change**. Over the 30-40 year life span of a power plant there will be major changes in nuclear and other technologies. Examples of these changes are the implementation of digital technologies and the changes in operation and design following the TMI and Chernobyl accidents. A professional development program that is based solely on a work place apprenticeship will not capture industry changes. Thus, the development program must be proactive to prevent a degradation as industry practices change.
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> **Global standards**. The nuclear industry has adopted global standards for power plant performance. These standards are promoted through reviews and audits by the IAEA and WANO. 'World Class' no longer means exceptional achievement, it is the expected norm. If the power plant is going to meet global standards, then all the supporting infrastructure (universities, suppliers, etc.) must also meet global standards.

There is some evidence that the 'ageing of staff' is a contributor to performance problems. It is not easy to prove conclusively the causal link. Nevertheless, based on my experience I believe there is a link with the following indicators.

1. The implementation of operational safety via the Operating Policies and Principles Document is being changed. Performance improvement programs are giving more detailed specifications of the safe operating envelope. The Operating Policies and Principles approach is based on a historical precedence for the basis of decision making. This approach will fail if the historical knowledge is not carried forward with new staff

members.

2. The CANDU industry did not move as quickly as other jurisdictions to adopt some of the more recent best practices in operational safety. For example, the emphasis on risk management through a better defined safe operating envelope is now being addressed as a performance improvement issue.
3. Within the CANDU industry there is an emphasis on safety design issues to the neglect of operational safety issues. For example, the design basis accident analysis continues to emphasize full power operation over shutdown configurations. As a result outage maintenance work is often subject to just-in-time assessments and 'work arounds'.

The root-cause analysis of abnormal events can identify deficiencies in an individual=s professional capability. However, the need for an improved professional development culture will manifest itself in a pattern of human performance failings. At the highest level, an on-going degradation of the overall plant performance is an indicator that professional conduct and development may be a contributing factor.

2.1 Attitudes to Professional Development

Many members of our industry are proactive in their professional development and continuously strive to achieve high standards. However, there are areas for improvement. The following are some of the negative attitudes I have observed, not infrequently, during my career.

Lack of personal commitment. Professional development is seen as the responsibility of the employer. If they pay me, I will learn.

Lack of commitment to quality. Work is not seen as a process that is continuously being improved.

Lack of understanding of decision making. The role of professional competence and experience in decision making is poorly understood (e.g. the incorrect application of the concept of engineering judgement).

Lack of participation in the technical community. Membership in organizations such as CNS is low. Attendance at conferences and symposia are seen as a perk or reward and not as an opportunity to achieve professional development objectives.

Lack of management commitment. Continuous professional development is not actively promoted as an integral part of employee performance.

Although these negative attitudes are a minority view they need to be changed. If the industry is to meet international standards, all the players have to meet the standard. To achieve the collective goal requires instilling a culture of continuous professional development. Provided the group or community adopts the attitude it will reinforce the need for all members to adopt it.

2.2 Safety Culture

The emphasis on safety culture at nuclear plants is related to the larger issue of qualifications and professional development. A successful safety culture requires that the staff have the knowledge and competence to perform their work with high quality while understanding the safety significance of it and the procedures. This leads to the following general requirements for training and education [Ref. 4]:

> *Instruction instills more than technical skills or familiarity with detailed procedures to be followed rigorously. These essential requirements are supplemented by broader training, sufficient to ensure that individuals understand the significance of their duties and the consequences of mistakes arising from misconceptions or lack of diligence.*

Table 1 summarizes some of the safety culture indicators related to the commitment for training and professional development.

Table 1 Selected Safety Culture Indicators Related to Training and Professional Development from Reference 4

Training

- Does all critical training and retraining culminate in formal assessment and approval for duties? What is the success/failure record? What is the proportion of operating staff's time devoted to training and how does this compare with the practices of other nuclear pant operators?

Attitudes of Individuals

- Do staff make maximum use of training opportunities? Do they adopt a responsible approach, complete necessary preparatory work and participate actively in discussions?

Review of safety performance

- Do staff routinely read and understand reports on operating experience?

Attitudes of Managers

- Are managers alert to the need to identify weaknesses in their staff, to specify training requirements or to provide other support?

Research input to safety analysis

- Is there a policy for regular publication of research results in journals that insist on refereeing by peers?

Performance of Regulatory Agencies

- Is there an education and training programme for regulatory staff?

- Does the regulatory agency participate actively in relevant international activities?

2.3 Continuous Professional Development

A personal commitment to continuous professional development is becoming a condition for maintaining professional certification. Most engineering associations in Canada have adopted programs [Ref. 3] and the concept is being applied internationally [Ref. 5]. There are many socio-economic factors driving this movement. However, the widespread introduction of quality programs with their emphasis on staff qualifications is a leading cause. The need to demonstrate professional qualifications is requiring assessments of individual competence and certifications that are auditable.

The engineering associations are addressing the issue by requiring each professional engineer to have a personal professional development program. The association will audit the members and assess the quality of their programs. In the case of New Brunswick (APENB), the program requirements are outlined in Table 2.

The APENB requires a three year rolling program accumulating a minimum of 240 professional development hours (PDH). In the absence of a three year program, the minimum is 80 PDH per year. Three points are to be noted:

1. The requirement is a minimum with the expectation being higher.

2. It is not possible to achieve the minimum through professional practice alone. It requires participation in the technical community and/or study.

3. It is difficult to exceed the minimum without the support of the employer.

Table 2. Professional Development Activity Categories and Levels Of Effort [Ref. 3]

Category	Examples	PDHs/Activity Hours	Max./Year
Professional Practice	Active professional practice as engineer	1 PDH/20 hours	40
Formal Study	Courses at/from universities, industry, employer, technical societies	1 PDH/hour *or* 10 PDHs/CEU *or* 10 PDHs/University Credit	30
Informal Study	Self-directed study, conferences, seminars	1 PDH/2 hours	30
Participation	Mentor to an EIT, service on public bodies, technical committees, etc.	1 PDH/hour	20
Presentation to Others	Conference or meeting	2 PDH/1 hour	20
Contributions to Knowledge	Codes and standards, patents, publications	1 PDH/hour	30

PDH = Professional Development Hour
CEU = Continuing Education Unit

3.0 ROLES OF EMPLOYER, EMPLOYEE AND SUPPORT INSTITUTIONS

There is a widespread perception that the employer has full responsibility for professional development. Apart from professional issues, this cannot work in practice because of the cost. The investment in an employee=s professional improvement is owned by the employee not the employer. Consequently, corporations are reluctant to invest in professional development beyond their short term needs. This is at odds with the long-term goals of the corporation and builds in an overall degradation of professional quality. Clearly, the employee has to assume most of the cost of long term professional development.

An individual is responsible for ensuring their competence is maintained throughout their professional career. The Association of Professional Engineers of New Brunswick state it as

follows [Ref. 3]:

> *The primary responsibility for professional development and maintaining competence rests with the individual professional engineer. This is inherent to all professions, and is reflected in the Association's By-Laws, Code of Ethics and past practice.*

The engineering profession differs from most others in that the designation of P.Eng. carries technical and legal significance. Since the P.Eng. is granted by an engineering association, it is a certification issue between the practicing engineer and the association. There is movement to an increasing use of professional designations because of the myriad of technical credentials being offered in the market place. For example, the Canadian Association of Physicists is introducing a professional designation. The use of a professional designation presumes an on-going relationship between the individual and the professional association to maintain its validity.

It is in the company's interest to support the employee in professional development and maintaining their competence. It is an integral part of the company's quality program. One measure of a company's effectiveness in achieving performance excellence is the Malcolm Baldrige Quality award criteria. Three areas are assessed under the management and development of human resources [Ref. 2].

- **Work systems**. The company's human resource management system should add to its performance and business objectives by enhancing the employee's contribution. This includes having a clear job description as well as compensation and recognition for achieving performance improvements

- **Employee well-being and satisfaction**. The company should maintain a work environment that promotes the employee's personal and career development.

- **Employee education, training and development.** The company should have a program for supporting and enhancing the performance and professional development of employees.

A company that has programs that satisfy the Baldrige criteria will be meeting its obligations for the professional development of its employees. These employer programs should be flexible enough to meet the employee's requirements for satisfying certification requirements with professional associations.

The professional associations, educational institutions and vendors of training programs all support an on-going professional development program. Access to the internet brings a wide

range of material and discussion groups to individuals. Thus, the individual can readily access support for their professional development. In Canada, the small size of the 'national' professional associations prevents them from offering a wide selection of support programs. However, the international or global associations, such as IEEE, afford access to a wide range of support.

It is important that the industry support the professional associations so that there is a pool of highly trained professionals available. This is made more important when there is a dwindling supply of entry level professionals from the universities.

3.1 Contract Employees

The rise in use of contract employees for professional services exacerbates the professional development issue. An employer assumes no responsibility for the development of a contract employee. On the other hand, the employee does not have access to affordable professional development options. In the case of the self-employed professional consultant, the billing rate provides the income to cover professional development. However, the consultant must see it as being in their long-term interest to invest in their skills.

4.0 ASSESSMENT OF COMPETENCY

To meet the performance objective of achieving a quality work product it is necessary to qualify staff to perform their assigned tasks. The measure of qualification is the individual's competence in the subject matter, procedures and practices of the work area. Traditionally, qualification has been assessed informally by supervisors based on their knowledge of the individual's work record. It is by necessity a subjective judgement and the supervisor is in the best position to make the assessment. The demands of modern quality assurance programs, compliance monitoring, professional certifications, and business practices are generating the need for a more formal assessment of competency.

Competency is a measure of an individual's capability to perform and direct work in a defined area of professional activity. It is a combination of knowledge, understanding, technical and communication skills, as well as the ability to apply vision and leadership.

The employee and employer can use the assessment of qualifications for assigned work as a measure of the success of the professional development program. An example of competency measures are those suggested by the IEE [Ref. 5]. They suggest two measures for their Continuing Professional Development Program. One is a four level categorization of competence in a professional area. The second is a more specific measure of competence that can be applied

to sub-areas or project task areas as well. Table 3 summarizes this five level scale.

The numeric scale of qualification in a specific area would be supported by the individual's professional development record. This includes the record of training, previous work, professional development credits, etc. In the spirit of continuing professional development, the qualification record must be timely. That is, there needs to be criteria for the validity of training and experience.

Table 3 - Qualification Level for Specific Technical Activities [Ref. 5]

1.	-	Performs the activity with significant supervision and guidance
	-	Performs basic routine and predictable tasks
	-	Little or no individual responsibility or autonomy
2.	-	Performs the activity in a range of contexts
	-	Supervision only required in more complex circumstances
	-	Some individual responsibility or autonomy
3.	-	Performs the activity in some complex and non-routine contexts
	-	Significant responsibility and autonomy
	-	Can oversee the work of others
4.	-	Performs the activity in a wide range of complex and non-routine contexts
	-	Substantial personal autonomy
	-	Can develop others in the activity
5.	-	Can take a strategic view
	-	Applies a significant range of fundamental principles and complex techniques across a wide and often unpredictable variety of contexts
	-	Wide scope for personal autonomy

5.0 IMPLEMENTATION OF CONTINUOUS PROFESSIONAL DEVELOPMENT

At Atlantic Nuclear we are implementing continuous professional development as an extension of our Quality Management (QM) System. The QM system is compliant with the ISO 9001 standard [Ref. 1]. The quality requirements are implemented at three levels: 1) Corporate

Policy (The Quality Assurance Manual), 2) Work Management (Quality Management Procedures), and 3) Work Performance (Corporate Instructions and Project Procedures).

The Quality Policy highlights the importance of competency and professional development in achieving total quality.

QUALITY POLICY

Atlantic Nuclear provides customers quality products and services through the application of "The Power of Excellence". The company's Quality Improvement Program guides and supports employees in performing their jobs with excellence.

The Quality Manual defines the policy and implements the program in accordance with the ISO 9000 series of standards. It builds on four elements to achieve total quality.

- *The Quality Manual shall be an integral part of all corporate work.*
- *The customer shall be included as an essential member of a project team.*
- *Projects shall be planned, managed and completed using procedures and methods that incorporate best industry practices.*
- *Staff assignments shall be made with due consideration of the experience, skills and training needed to perform the work with excellence.*

The company's QM system is implemented at the work level through the Project Managers. All work within the company is treated as a project with a Project Manager. This includes corporate management functions such as information systems, resource management, etc. A business management system provides an umbrella and reporting structure for the Project Managers.

The Quality Assurance Manual states the corporate training policy and two Quality Management Procedures implement it. The two procedures cover the short term need of competence to perform project work and the longer term need for professional development:

(1) Management Procedure for Projects; and
(2) Management Procedure for Staff Development.

The implementation of the program is summarized in the following sections. The program is consistent with the APENB's Continued Competency Assurance Program [Ref. 3] and applies

to all professional staff.

5.1 Training for Project Work

The Project Managers have the responsibility for ensuring that the staff assigned to projects are qualified for their work. This is covered under the Management Procedure for Projects. It requires the Project Manager to prepare a Project Quality Plan for client approval. The Quality Plan addresses the qualifications of the project staff. If training is required to qualify the staff, it is identified in the Quality Plan and managed as part of the project.

5.2 Staff Development

The professional development of staff is an in-house project of Business Management. The Management Procedure for Staff Development implements the requirement for professional development of staff. It includes the following requirements:

(a) Employees adopt the company's Quality Policy as their own for competency and performance excellence.
(b) Employees have responsibility for their continued competency and professional development.
(c) The company supports the employee's professional development through mentoring, work assignments, financial support, etc.
(d) Each employee prepares a professional development plan in consultation with management. The plan must include specific objectives and schedule for one year and direction for three years ahead.
(e) The company monitors and evaluates the professional development of the employees. It is a part of the employees overall performance assessment and annual review.

5.3 In-house Training and Development

A small company cannot support a full scale training department. Nevertheless, there is an abundance of technical material readily available for developing competency as a nuclear engineer or scientist.

Atlantic Nuclear has assembled in-house a wide range of training materials for use in the qualification of staff for specific tasks and for professional development. The subject areas are summarized in Table 4. In each subject area there is a three tier level of documents:

Level 1 – Overview / Policies & Principles

Level 2 – Knowledge Base & Guides

Level 3 – Practices and Procedures

Level 1 and Level 2 training would be covered in the on-going professional development program. The Level 3 material serves mainly for qualification for project task. The documentation is primarily from the AECB, IAEA and US NRC with material from the technical literature and external courses.

Table 4. Atlantic Nuclear Training for Nuclear Facility Design and Operation

1. **Technical Background** - Science and engineering fundamentals at the text book level for nuclear physics, fluid mechanics, heat transfer, structural analysis, instrumentation, reliability, software engineering.

2. **ANSL Quality Management System** - Training for Atlantic Nuclear's Quality System and codes and standards

3. **CANDU Nuclear Power System** - System Description of CANDU systems and processes.

4. **Reactor Safety Objectives** - Basic safety principles, defense-in-depth, reactor accidents, risk analysis, socio-economic impacts, health effects.

5. **Reactor safety design** - Safety design principles, special safety systems, safety related systems, seismic and environmental qualification, fuel design, reactor physics, criticality, design basis safety analysis, probabilistic safety assessments, reliability, containment behaviour, severe accidents, containment behavior.

6. **Regulatory Environment** - Nuclear Safety and Control Act, regulations, nuclear liability act, licensing process, regulatory, guides, policies and standards, reactor operating licence, reporting requirements, international agencies.

7. **Nuclear Plant Management** - Safety culture, reliability and performance, station management programs (maintenance, emergency preparedness, radiation protection, staffing, record keeping, waste management), work management, training, design and change control.

8. **Reactor Safety in Operation** - Implementation of the safe operating envelope, operational safety, in-service inspection, emergency plans, reactor safety performance measures.

9. **Radiation Protection -** ALARA Principle, radiation protection standards, effects of ionizing radiation, measurement of radiation, management of radioactive releases, handling and transportation of radionuclides, environmental impact, management of radiation emergencies.

10. **Computer Code User Qualification** - Certification of users of computer codes used in nuclear safety.

6.0 SUMMARY

It can be difficult to separate institutional from individual failings. The following questions focus on many of the issues separating individual and institutional performance:

1. How does the institution recognize the need for improved professional conduct and professional development?

2. How is responsibility for professional development shared between the employee and the employer?

3. How can professional development programs be implemented and made effective?

The questions can be answered if the quality management system includes continuous professional development as an essential component. In addition to task specific training it should embrace the employee's personal development program. It should be compatible with the employee's need to meet the requirements of professional associations. The assessment of qualifications within the quality program will identify deficiencies with regard to work assignments and measure the success of the overall development program.

Based on the models discussed, an assessment of the health of a professional development culture would include the following indicators:

- ❑ employee/employer commitment
- ❑ linkage with career progression
- ❑ balance among development activities
- ❑ support from professional associations
- ❑ integration into the quality management system.

To implement an effective professional development culture requires acceptance of a long-term action plan by the employer and employee. Atlantic Nuclear is developing an in-house model which is an integral part of the quality management system. Each employee has a professional development action plan with career development objectives. The qualification of the individual to perform assigned work is assessed by their Project Manager. At the start of a project, a Quality Plan is prepared and presented to the client for acceptance. The plan includes a statement of qualifications for the project team members and supplementary training requirements.

7.0 REFERENCES

1. ANSI/ASQC Q9001-1994 – *Quality Systems – Model for Quality Assurance in Design, Development, Production, Installation and Servicing*, Section 4.18.

2. *Conducting an Organizational Self-Assessment using the 1997 Baldrige Award Criteria*, M. Caravatta, Quality Progress, October 1997, p. 87.

3. *Continued Competency Assurance Program*, Association of Professional Engineers of New Brunswick, Interim Report, January 1999.

4. *Safety Culture,* IAEA Safety Series No 75-INSAG-4, 1991

5. *A New Approach to CPD, The Institution of Electrical Engineers*, http://www.iee.org.uk/cpd/ April 1999