

Principles of Nuclear Safety

Module 2

Safety Management and Safety Culture

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Definition of Nuclear Safety

Nuclear Safety is the protection of workers, the public and the environment from radiological hazards arising from the operation of nuclear power plants.

It includes the operating philosophies, management and work practices, policies, principles, procedures, equipment and systems in place to minimize the risk of a serious accident involving a radioactive, environmental release.

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Public Safety Vision

No injuries to the public resulting from Ontario Hydro's operations, facilities or products.

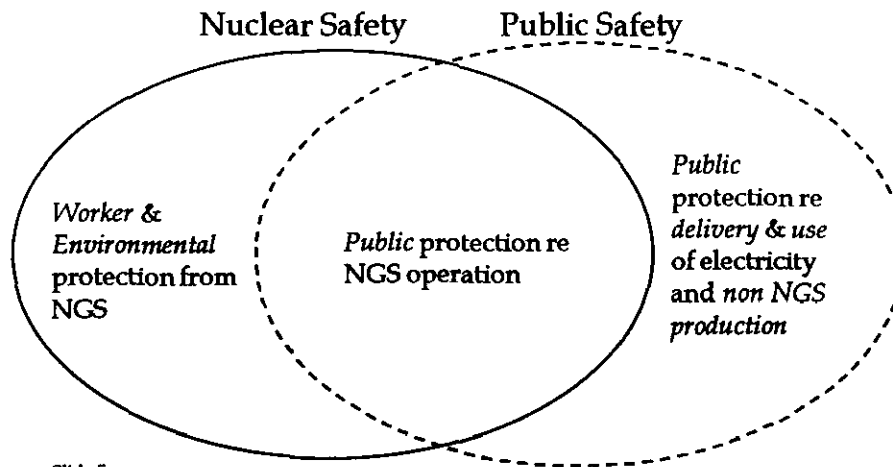
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Public Safety Goals

- ❖ To control the risks of injury to the public associated with the *production* of electricity
- ❖ To minimize the risks of injury to the public associated with the *delivery* of electricity
- ❖ To promote and influence the safe *use* of electricity *by the consumer*

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Nuclear Safety Versus Public Safety



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How do we manage Nuclear Safety?

The same as we manage any other program.

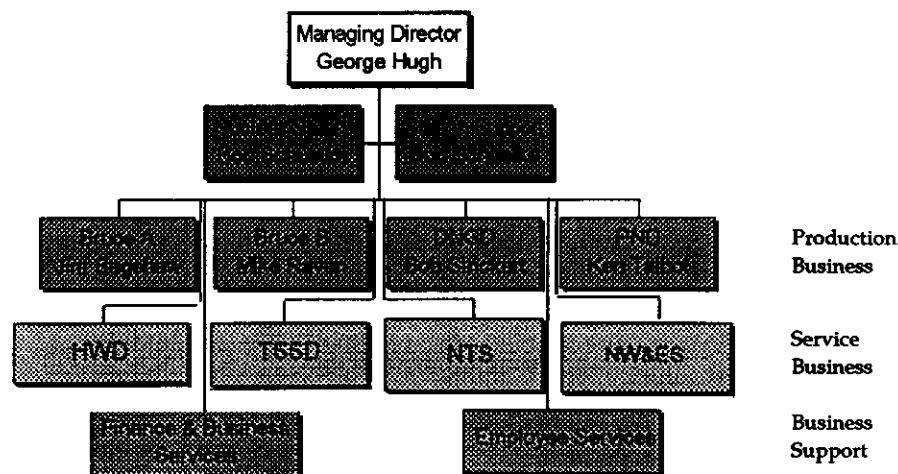
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Generic Managed Process

- ❖ Vision/Mission, Goals & Objectives
- ❖ Primary Delivery Functions
- ❖ Resources/budget
- ❖ Policies & procedures
- ❖ Organization—roles & responsibilities
- ❖ Plan & Control
 - ◆ KEAs, measures, standards, targets
 - ◆ Performance monitoring; Corrective Action

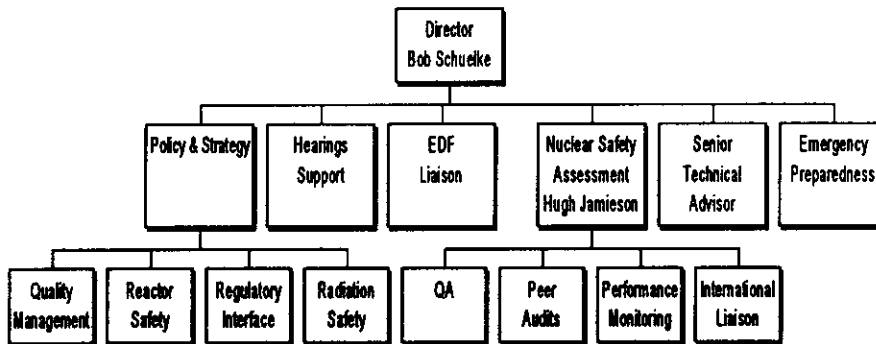
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OH Nuclear Line of Business Organizational Chart



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Nuclear Safety Division Organization



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Nuclear Safety Division Primary Delivery Functions

- ❖ Nuclear Safety *policy & strategy*
- ❖ Performance monitoring & reporting
- ❖ PEER, QA Audits
- ❖ Liaison INPO/WANO/AECB/Govt.
- ❖ Generic Nuclear Safety & licensing issues
- ❖ Radiation safety & Corporate EP
- ❖ NIRC Secretariat function

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Key Effectiveness Areas

1. Worker Radiation Safety
2. Public Nuclear Safety
 - ◆ Equipping the Organization
 - ◆ Defining the safe operating envelope
 - ◆ Accident prevention
 - ◆ Accident mitigation
 - ◆ Accident management
3. Environmental Nuclear Safety

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OH Nuclear Safety Performance Measures

1) Worker Radiation Safety:

- ◆ Collective dose per unit per year

2) Public Nuclear Safety:

2.1 Equipping the organization

- ◆ OP&P non compliance frequency

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OH Nuclear Safety Performance Measures

2) Public Nuclear Safety (Cont'd...):

2.2 Defining the safe operating envelope

- ◆ Frequency of operation outside SOE

2.3 Accident Prevention

- ◆ Reactor trips per 7000 hours
- ◆ Frequency of serious process failures

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OH Nuclear Safety Performance Measures

2) Public Nuclear Safety (Cont'd...):

2.4 Accident Mitigation

- ◆ Special Safety System availability

2.5 Accident Management

- ◆ Response to real and simulated incidents

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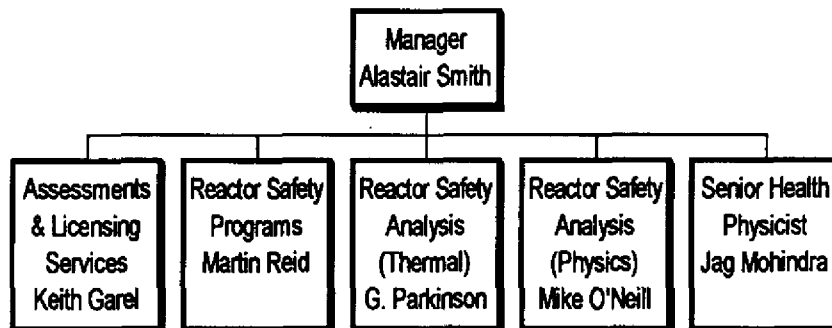
OH Nuclear Safety Performance Measures

3) Environmental Nuclear Safety:

- ◆ Dose to person living at exclusion zone boundary (Radiological Emissions Impact Index)
- ◆ Annual volume of solid radioactive waste produced

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PND Safety Department Organizational Chart



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Station Nuclear Safety Dept. Primary Delivery Functions

- ❖ Safety analysis/risk assessment
- ❖ Advise Management
 - performance trends
 - licensing issues
- ❖ HPES/root cause investigations
- ❖ Emergency preparedness (DNGD)
- ❖ Operating Experience program
- ❖ Fuel & Physics program
- ❖ Documentation (QTR, AIM, OP&P, Safety Report)

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When is our Nuclear Safety Management successful?

When we are meeting our
performance targets, providing
they compare favourably with
international benchmarks

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Role of Government in Promoting Nuclear Safety

- ❖ Legislate safety policies and standards
- ❖ establish and support institutions and regulatory agencies
- ❖ Promote international exchange of information
- ❖ Empower Regulators to enforce laws

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Federal and Provincial Acts Impacting Nuclear Power Plant Design, Operation & Maintenance

Atomic Energy Control Act

- ❖ Administered by Federal Ministry of Energy, Mines & Resources
- ❖ Authorizes existence of AECB to control and license production of atomic energy
- ❖ defines limits of AECB's authority
 - including authority to prosecute offenders
 - powers to make binding regulations
 - ◆ AEC Regulations
 - ◆ Physical Security Regulations
 - ◆ Transport and packaging of radioactive materials Regs

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Transportation of Dangerous Goods Act

- ❖ Requires shippers to file emergency response plan with Federal MOT
- ❖ Requires shippers to maintain an emergency response capability for traffic accidents involving their radioactive shipments

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Environmental Protection Act

- ❖ Lays out emission limits binding on Ontario Hydro
- ❖ Requires notification of spills to Provincial MOEE
- ❖ Mandates MISA program of emissions reporting and reduction

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Boiler & Pressure Vessels Act

- ❖ Obliges station to report immediately pressure boundary ruptures to Provincial MCCR
- ❖ MCCR approves the following:
 - proposed welding procedure and QC test prior to job
 - return to service after repair
 - Welders and QC Technicians qualifications

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Nuclear Liability Act

- ❖ limits Utility liability for damages due to nuclear accident to \$75 million
- ❖ Federal Government administers claims pursuant to nuclear accident, covering amount over \$75 million

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Emergency Plans Act

- ❖ Administered by Provincial MOSG via *Emergency Measures Ontario*
- ❖ Gives Province emergency powers upon declaring a nuclear emergency
- ❖ Gives Provincial Nuclear Emergency Plan (PNEP) legal status
- ❖ Each NPP to have a radiation emergency response plan consistent with the PNEP

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Definition of Safety Culture I

(INSAG 4, IAEA)

“Characteristics and attitudes of organizations or individuals which establish that, as an overriding priority, nuclear power plant safety issues receive the attention warranted by their significance.”

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|---|
| <p><i>Safety Culture</i> as a nuclear safety concept was established after the Chernobyl accident.</p> |
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Definition of Safety Culture II

(CBI definition)

The mix of shared values, patterns and behaviour that give the organization its particular character. Put simply, it is “the way we do things around here” ... the safety culture of an organization could be described as the ideas and beliefs that all members of the organization share about risk, accidents and ill-health.

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Definition of Safety Culture III

(ACSNI definition)

The safety culture of an organization is the product of individual and group values, attitudes, perceptions, competencies and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organization's health and safety management.

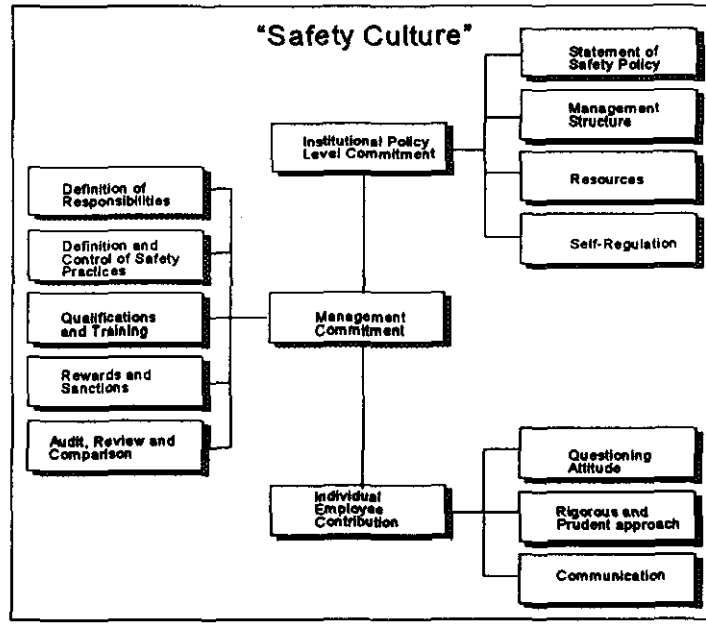
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Safety Culture Prerequisites

Commitment at all levels:

- ❖ Institutional/Executive
- ❖ Management
- ❖ Individual Employees

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Good Work Practices

- ❖ Self-checking
- ❖ Independent verification
- ❖ Pre-job briefing
- ❖ Procedural compliance
- ❖ Conservative decision making
- ❖ OP&P training

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Self Checking

- ❖ Do it right the first time
- ❖ Personal error reduction stratagem
- ❖ “STAR” mnemonic:
 - *Stop*--before acting
 - *Think*--anticipate system response
 - *Act*--perform action
 - *Review*--confirm system response

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Independent Verification

- ❖ Personnel error reduction stratagem
 - Critical procedures
 - complex and/or infrequent operations
 - work protection
- ❖ Second qualified person verifies every step *before* implementation
- ❖ Requires full attention of both parties

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Conservative Decision Making

- ❖ Basing decisions on the best facts available, and where facts are not available, taking the most conservative choice to protect public and staff safety
- ❖ Never compromising safety for productivity
- ❖ Taking a cautious, well considered approach to reactor operation
- ❖ Never proceeding in the face of uncertainty

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Conservative Decision Making

- ❖ Reference INPO SOER 94-1 on Salem marsh grass incident
- ❖ Crew persisted with controlled shutdown, when plant conditions required more conservative actions-- turbine trip and then a reactor trip.

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Performance Measures Reflecting Safety Culture

- ❖ Frequency of OP&P violations
- ❖ Frequency of SERs due to LTA
 - self checking
 - independent verification
 - conservative decision making
 - pre-job briefing
 - procedural compliance
 - communications
 - supervision/managerial methods

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Safety Culture at TMI and Chernobyl

- ❖ At TMI, Misdiagnosis and inappropriate actions resulted in core melt-down
- ❖ At Chernobyl, the primary cause of the power excursion was a series of deliberate operating violations—safety systems were bypassed to keep the unit operating
- ❖ Poor safety culture at all levels both cases

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