U.S. Nuclear Quality Problems Persist

The Case for Nuclear Management System Advisor / Designer Certification Program
“Quality Assurance Problems Persist at Waste Treatment Plant”

**Source:** American Nuclear Society NN Article, June 2018

U.S. General Accounting Office, Report to the Committee on Armed Services, U.S. Senate
Quality & Quality Assurance Problems

1974 ~ 2018

‘Quality Assurance Problems’ Persist in The ‘N’ Word Industry

- ‘Quality’ & ‘Quality Assurance’ Confused from Day One (1965) - Was It?
- ‘Quality’ - Does Everyone Fully Agree on What ‘Quality’ Means & How it Fits into the Work?
  - Intent | Definition | Applicability | Perception | Ownership | Expectations | Levels | Results
- Are ‘Quality Problems’ & ‘Quality Assurance Problems’ the Same?
- Is the Term ‘Quality’ Understood & Used Consistently?
- Is ‘The Quality Problem’ mostly Technical or Administrative?
- Does Everyone Unconditionally Endorse ‘Quality’ as Defined by their System, Program, or Project?
- Does Everyone Know that ‘Quality’ is merely Determining if Requirements have Been Met?
- Does Everyone know all Requirements for their Responsibilities & Perform them Correctly each Time?
- Is Everyone Afraid to admit the ‘Quality Problem’ is Theirs when they Caused it - Termination?
- Are there Other Related Questions?
Were Terms ‘Quality,’ ‘Quality Assurance,’ & Perceptions Wrong from the Start?

Nuclear Safety, Quality, & Quality Assurance

‘Nuclear’ – 1960s Building Nuclear Power Plants didn’t seem to be a big deal other than the word NUCLEAR. Considering the Cold War was less than 20 years in the making, it had its visible human reaction by many when you said *The ‘N’ Word*. ‘Quality’ & the ‘Assurance of Quality’ is Synonymous with Nuclear Safety.”

*Is a ‘Quality Problem’ the Same as a ‘Quality Assurance Problem’?*

‘Quality’ – Conformance to Requirements. This word has always evoked an extremely wide range of emotions & perceptions. It has been mis-used and mis-precepted for decades. It has been the basis for ongoing arguments, contract disputes, law suits, and employee terminations.

‘Quality Problems’ – The result of not meeting requirements.

‘Quality Assurance’ – Those planned and systematic activities implemented within the quality system that can be demonstrated to provide confidence** that a product or service will fulfill requirements for quality. **VERIFICATION

‘Quality Assurance Problems’ – The result of not effectively planning & systematically executing activities to demonstrate conformance to requirements. **VERIFICATION ACTIVITIES

Are Quality Problems Technical or Administrative?
Quality

Technical | Administrative

- Where is Quality Taught - Home, Playground, School, Work?
  - The More Technical the Work, The More Complex the Administrative Controls - a Parallel Process
  - The More Technical the Work, The More Complex to Determine ‘Conformance to Requirements’
- Technical (science) - we think of scientists, engineers, doctors, lawyers, researchers, technicians
  - When People are Faced with Something Complex it Sounds & Seems Technical
- Administrative (business) - we think of managers, executives, secretaries, clerks, typists, paperwork
- Is Understanding Quality Simply a Language or Perception Issue (education)?
  - Language Issue - Unique Terms Just Like Any Other Discipline (lack of education)?
  - Perception Issue - The ‘Minds Eye’ Plays the Key Role in Understanding Quality in Application
‘Quality Assurance Program’ v. ‘Nuclear Management System’

**Scope:** Nuclear Quality Was Limited from the Start

‘**Nuclear Management System**’ A Nuclear QA Program is only one of many programs within the “Management System.”

“Until the ‘**Management of Quality**’ is in the boardroom as mandated by the CEO, Quality will always be perceived & placed at a lower level in the workforce. People always watch direction & priority set by top management. They know where quality is in the minds of the CEO & Executive Staff.”

Systems are company-specific due to scope, commitments, baseline requirements, interface needs, information management process design, other requirements.
Nuclear Quality - Knowledge Transfer

Knowledge Transfer Gap

U.S. Management of Nuclear Quality

1960
- U.S. Leaders Emerging
  - Dr. Walter A. Shewhart
  - Dr. W. Edwards Deming
  - Dr. Armand V. Feigenbaum
  - Dr. Joseph M. Juran
  - Philip B. Crosby

- ‘Conformance to Requirements’
  - 1970 Concept Emerged

1960 Articles & Books on Quality

1960 Major Emphasis on Quality | Safety

Project Management Institute (PMI) Formed

1964 ISO Formed

1971 OSHA Regulations

‘Cost of Poor Quality’ U.S. Military Supply Chain

1950 – 1959 LNPP Design | Build Period
- 65 LNPP Sites & 160 Power Reactors

1957 IAEA Founded

1962
- MIL-Q 9815A
- MIL-STD-570

1965 New Codes / Standards

1970 NRC QA Public Law 105-245 Appendix A

1974
- NRC Regulatory Guides
  - RG / Code | Standard Upgrades
  - Assessments & Oversight

1979 Accident
- Three Mile Island NPP

1984 U.S. NRC NUREG-1055 Report to Congress

1985
- NRC NUREG-1055 Report to Congress

1986
- NRC NUREG-1055 Report to Congress

1987
- IMS, QMS, EMS, RM, SCM, Others
- Requirements Matrix (Advanced)
- Process Mazclad Mgt
- Enterprise Software (Advanced)
- Cyber Security
- Supply Chain Mgt (Advanced)
- Post 911 Safety | Security
- 2006: ISO 9001 GMS Certified
  - .5 million, among 155 Countries

1990 QMS | EMS

2000 IMS

2010 Culture

2020 CS | AI

2030

60 Years

1960 – 2020
Numerous global non-nuclear industry sectors have been implementing ISO 9001 Quality Management Systems & quality tools since 1987.
- QMS certifications now exceed 1.5 million.
- Many nations require certification as a part of product/service system safety basis certifications.
- This model also suggests the industry may require provisions for implementing ‘Integrated Management Systems.’

Will U.S. Nuclear Industry executives recognize & integrate advanced Quality Management Tools to enhance overall operational effectiveness?

2018 New ISO 19443 Nuclear QMS

The U.S. chemical, oil, and gas industries have a history of QC, inspection, & testing as the methods for ensuring safety & specification compliance. In the mid-’60s, the nuclear industry initiated QA with the goal of ‘error prevention.’

- Does the nuclear industry recognize the ‘Management of Quality’ & its focus is driven by company executives?
- Do executives recognize & embrace advanced ‘Quality Management Tools’ available to enhance, safety, effectiveness, & compliance?
- Will industry members realize the benefits by unconditional support?

Knowledge Transfer Gap
Quality Problems - U.S. Industry Failures

Business Cases 1974 ~ 2018

‘The Quality Problem’

- 1974 U.S. Power Engineering - A Message to Industry
  - First Generation U.S. Fleet NPPs Design / Build - Major Regulatory Quality Assurance Concerns

- 1979 U.S. Three Mile Island Accident - PA
  - First U.S. Fleet NPPs - Quality Failure

  - Construction of NPPs” First U.S. Fleet NPPs - Quality Failures & Successes

- 2008 U.S. Nuclear Regulatory Commission, December 2008 NRC Workshop HQ
  - Supply Chain Oversight New Reactor Construction - Cites U.S. NRC NUREG-1055-1984

- 2009 U.S. GAO Report 09-61, DOE Needs to Strengthen Facility Oversight
  - Nuclear Safety Oversight Failure - Quality Failure

- 2017 U.S. BWX Technologies mPower SMR NPP Design Development for DCA
  - Design Assurance Quality Failure

- 2017 U.S. Westinghouse Nuclear AP1000 NPP
  - VC Summer Columbia, SC - Design / Build Quality Failures

  - Quality Assurance Program Failure
What Do You Think After Reading The Article Title & Then Seeing The Picture?

Bearing Down on What – Quality Employees or QA Employees?

PERCEPTION PROBLEM? WRONG TERM IN THE MESSAGE?
Quality Problems - 1979

U.S. Three Mile Island Accident - PA
- First U.S. Fleet NPPs - Quality Failure

1979 Accident
Three Mile Island NPP

At the request of Congress, NRC required to conduct a study of existing & alternative programs for improving quality & the assurance of quality in the design & construction of commercial NPPs.


The report focus is on the “Management of Quality”
- Construction of NPPs” First U.S. Fleet NPPs - **Quality Failures & Successes**

**Cancellations driven by 1979 TMI accident Pennsylvania**
Zimmer – Ohio
Marble Hill – Indiana
Quality Problems - 2008

U.S. Nuclear Regulatory Commission, December 2008 NRC Workshop HQ
- Supply Chain Oversight New Reactor Construction - Cites U.S. NRC NUREG-1055-1984

NRC Workshop on Vendor Oversight for New Reactor Construction

NRC Perspective on the Vendor Inspection Program for New Reactors

Glenn M. Tracy, Director
Division of Construction Inspection & Operational Programs
Office of New Reactors

“Those who cannot remember the past are condemned to repeat it.”

December 10, 2008
NRC Workshop on Vendor Oversight for New Reactor Construction
U.S. GAO Report 09-61, DOE Needs to Strengthen Facility Oversight
- Nuclear Safety Oversight Failure - **Quality Failure**

**Quality Problems - 2009**

**NUCLEAR SAFETY**
Department of Energy Needs to Strengthen Its Independent Oversight of Nuclear Facilities and Operations
Quality Problems - 2017

U.S. BWX Technologies mPower SMR NPP Design Development for DCA - Design Assurance Quality Failure

BWXT & Bechtel Quietly Terminate mPower SMR Program


Fortes, March 13, 2017, Rod Adams, contributor

On March 3, 2017 Bechtel notified BWXT that it was unable to secure sufficient funding to continue the Generation mPower program and was invoking the settlement scenario provisions of the framework agreement announced in March 2016 for terminating the program.

Bechtel's communication marked the end of a one-year period during which Bechtel assumed the project lead from BWXT, the original developer of the mPower concept. During that period project partners shared the primary goal of securing additional investments that would allow the reactor development and certification process to be completed.

As a result of the termination notification, BWXT will pay Bechtel a $30 million settlement as Bechtel's sole and exclusive remedy, as agreed by both companies in the framework agreement filed in 2016. (This amount has already been recognized in BWXT’s financial statements as of March 31, 2016.)

BWXT will bring its mPower technology development efforts to a close in the next few months, and Generation mPower LLC will terminate its mPower program.

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<th>Design Start:</th>
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<td>DCA Target:</td>
<td>2013 Original</td>
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<tr>
<td>Last Target:</td>
<td>2017 March, Bechtel Cancelled Program</td>
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<td>Cancelled:</td>
<td>2017 March, BWXT Stopped Program</td>
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Quality Problems - 2017

U.S. Westinghouse Nuclear AP1000 NPP
- VC Summer Columbia, SC - Design / Build Quality Failures

VC Summer Columbia, SC – Design / Build Quality Failures
Westinghouse Nuclear AP1000 Reactors 2 Units
Program Start: 2008
Operation Start: 2014 Original
Cancelled: 2017 $9 Billion w/ Litigation

State senators file bills in face of $9 billion nuclear fiasco in South Carolina
By Andrew Brown abrown@postandcourier.com Dec 6, 2017 Updated Dec 8, 2017 (4)

SCANA launching its own probe into allegations of nuclear project mismanagement
By AVERY G. WILKS awilks@thestate.com
July 13, 2018 05:32 PM
Updated July 13, 2018 06:32 PM
COLUMBIA, SC — SCANA said Friday it would launch its own investigation into whether its board and top executives mismanaged a failed nuclear construction project, failing shareholders in the process.

- Quality Assurance Program Failure

“Quality Assurance Problems Persist at Waste Treatment Plant”
ANS NN Article, June 2018

U.S. General Accounting Office, Report to the Committee on Armed Services, U.S. Senate
NOTES:
1) This report describes many of the same “Quality Problems” described in U.S. NUREG-1055-1984
2) See ANS NN June 2018 article, “Quality Assurance Problems Persist at WTP”

Construction Start: 2001
Operational Target: 2007 Original
Operational Target: 2025 Now
Quality Problems - 2018

U.S. DOE Hanford Site Waste Treatment Plant (WTP) - Washington State

GAO Report 18-241 Cites the Zimmer NPP 1982 Construction Failure more than $2 billion. Marble Hill NPP in Indiana was cancelled 1982 for the same failures at the same financial loss.

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Settlement of Allegations of Contractors Knowingly Mischarging Costs at the Waste Treatment and Immobilization Plant (WTP)

In November 2016, the WTP contractor and certain subcontractors agreed to pay $125 million to resolve allegations under the False Claims Act that they made false statements and claims to the Department of Energy (DOE) by charging DOE for deficient nuclear quality materials, services, and testing that were provided to the WTP at DOE’s Hanford Site. The contract required materials, testing, and services to meet certain nuclear quality standards. The Department of Justice alleged that the defendants violated the False Claims Act by charging the government the cost of complying with these standards when they failed to do so. In particular, the Department of Justice alleged that the defendants improperly billed the government for materials and services from vendors that did not meet quality control requirements, for piping and waste vessels that did not meet quality standards, and for testing from vendors that did not have compliant quality programs. As part of the settlement, the contractors admitted no wrongdoing, and the United States did not concede that its claims were not well founded.

Source: Department of Justice. | GAO-18-241

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A Cautionary Tale: Quality Assurance Problems Doom Commercial Nuclear Power Plant

In the commercial nuclear industry, there is a notable example of a construction project that faced significant quality assurance challenges. In the 1970s and early 1980s, Cincinnati Gas & Electric attempted to construct a commercial nuclear power plant, known as the Zimmer Plant, near Moscow, Ohio. After 10 years of construction and more than $2 billion spent, the company abandoned its efforts to construct the plant. An independent review mandated by the Nuclear Regulatory Commission in 1982 concluded that several issues impeded successful construction of the Zimmer Plant as a commercial nuclear power plant. These issues included (1) the company’s failure to elevate its commitment to quality and quality assurance to an equal status with cost and schedule, (2) the regulator’s failure to hold the company accountable for quality in design and construction, and (3) the company’s inadequate quality assurance procedures. To recoup some of the $2 billion spent in attempting to construct this commercial nuclear power plant, Cincinnati Gas & Electric later converted facilities built at the site for use in a coal-fired power plant.

Source: Nuclear Regulatory Commission. | GAO-18-241

1982 Impact
1974 - Power Engineering

The AEC Bears Down on Nuclear Quality Assurance

Materials, systems and operations are improving under QA, but the rising level of integrity is hard to measure; reports show only the number of failures without reference to the number of opportunities for failures, while the AEC and the intervenors try to outdo each other in criticizing the QA performance

By F. C. OLDS, Senior Editor

2017 - Westinghouse Nuclear

State senators file bills in face of $9 billion nuclear fiasco in South Carolina

By Andrew Brown, awbrown@postandcourier.com Dec 8, 2017 Updated Dec 9, 2017

SCANA launching its own probe into allegations of nuclear project mismanagement

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On March 3, 2017 Bechtel notified BWXT that it was unable to secure sufficient funding to continue the Generation mPower program and was invoking the settlement scenario provisions of the framework agreement announced in March 2016 for terminating the program.

2018 - U.S. GAO DOE

“Quality Assurance Problems Persist at WTP”

United States Government Accountability Office

Report to the Committee on Armed Services, U.S. Senate

April 2018

HANFORD WASTE TREATMENT PLANT

DOE Needs to Take Further Actions to Address Weaknesses in Its Quality Assurance Program

Page 24
Will the NRC be directed to prepare another Report to Congress?
NUREG-1055-Edition 2.0

Focus on Your Management System
Quality Management System
Quality Assurance Program

02-14-18 NRC Report tell-tale page 17

Rev 7 QM System document
Higher rev number than normal to 'settle done as compliant'
QMS docs settle down at rev 2 to 5

Rev 40 QA Program document
This quality program document was "audited into compliance" Rev 40???
QA level program docs settle down at rev 5 to 12

The inspectors selected specific inspection criteria and critical attributes for the SSCs, along with inherent characteristics of engineering programs, to verify if the program controlling design activities had been established and were correctly implemented in accordance with a sampling of sections related to design control for safety-related software applications and training/qualifications in documents QMS, “Quality Management System – A,” Revision (Rev.) 7, and WCAP-12308, “ASME III Quality Assurance Program,” Rev. 40. The criteria selected by the inspectors also considered requirements included by reference to test codes and references to requirements contained in the UFSAR. In addition, the inspectors selected a sample of critical attributes and scenarios to determine if internal and external events or hazards could affect the component's performance and if that could result in a more than minimal impact to the conclusions made in the WEC transient analysis and in Chapter 15, "Accident Analyses," of the UFSAR.

For each of the PXS components, the inspectors selected a sample of stress and design analyses for subcomponents to verify if the design inputs were correctly
U.S. NPP Evolution

1950 ~ 1999
1st Design / Build Era

1950 ~ 1985

1969
10 CFR 50 App B Nuclear Quality

Renaissance 2000 ~

Gen I
Early Prototypes
• Shippingport
• Dresden
• Magnox

Gen II
Commercial Power
• PWRs
• BWRs
• CANDU

Gen III
Advanced LWRs
• CANDU 6
• System 80+
• AP600

Gen III+
Evolutionary Designs
• SMR
• AP1000
• ACR1000
• ABWR
• APWR
• ESBWR

Gen IV
Revolutionary Designs
• Safe
• Sustainable
• Proliferation Resistant & Physically Secure

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<tr>
<th>Year</th>
<th>Gen I</th>
<th>Gen II</th>
<th>Gen III</th>
<th>Gen III+</th>
<th>Gen IV</th>
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<td>1960</td>
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<td>2040</td>
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The Dynamic Human Resource Problem
“Cost & scheduling to pre-qualify, train, certify, & knowledge maintenance”

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<th>Year</th>
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<tr>
<td>ANS</td>
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<td>WNN</td>
<td>2015</td>
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<td>NEI</td>
<td>2014</td>
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U.S. NRC Report to Congress
NUREG-1055-1984
Nuclear Quality Management Failures

“Are We Leveraging from the Past”?
The Dynamic Supplier Resource Problem

“Cost & time to pre-qualify, certify, & sustain a robust qualified supply chain”

American Nuclear Society
Annual Buyers Guide

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<tr>
<th>First Gen Design / Build</th>
<th>Renaissance 2000</th>
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<tr>
<td>1986</td>
<td>2005</td>
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<tr>
<td>Suppliers</td>
<td>2,260</td>
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<td>2012</td>
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Renaissance 2000
50% Drop in Qualified / Certified Suppliers

15 Year Supply Chain Resource Gap

1950
### Quality Problems - 1912 ~ 2011

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<tr>
<th>Year</th>
<th>Event Description</th>
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<tr>
<td>1912</td>
<td>RMS Titanic Atlantic Ocean (UK)</td>
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<td>1941</td>
<td>World War II Mass Production (U.S.)</td>
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<td>1955</td>
<td>Post-War Aerospace (U.S.)</td>
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<td>1955</td>
<td>Naval Nuclear Program (U.S.)</td>
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<td>1955</td>
<td>Atoms for Peace (Global Effort)</td>
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<td>1960</td>
<td>Global Space Race (NASA, U.S.)</td>
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<td>1968</td>
<td>Commercial Nuclear Power (U.S.)</td>
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<td>1979</td>
<td>TMI Unit 2 (Pennsylvania, U.S.)</td>
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<td>1984</td>
<td>NRC NUREG-1055 Report to Congress</td>
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<td>1986</td>
<td>Nuclear Industry Quality / Safety / Management Failures (U.S.)</td>
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<td>1986</td>
<td>Challenger Shuttle (U.S.)</td>
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<td>1986</td>
<td>Chernobyl (Russia)</td>
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<td>1988</td>
<td>Piper Alpha Oil Spill (North Sea)</td>
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<td>1989</td>
<td>Exxon Valdez Oil Tanker Spill</td>
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<td>2001</td>
<td>911 (New York City, U.S.)</td>
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<td>2002</td>
<td>Prestige Oil Spill (Spain)</td>
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<td>2002</td>
<td>Davis Besse’ Reactor Head (Ohio, U.S.)</td>
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<td>2003</td>
<td>Columbia Shuttle (U.S.)</td>
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<td>2008</td>
<td>Metrolink Train (Southern CA, U.S.)</td>
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<td>2008</td>
<td>B2 Bomber Crash (U.S.)</td>
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<td>2010</td>
<td>Deepwater Horizon BP Oil Spill, Gulf of Mexico, 87 Days, (UK)</td>
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<td>2011</td>
<td>Fukushima Daiichi (Japan)</td>
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Drivers for Improved Quality & Safety
Integrated Management Systems and Quality Assurance Lead to Improved Safety and Business Performance, IAEA Meeting Hears

Elisabeth Dyck, IAEA Department of Nuclear Energy
Shani Krikorian, IAEA Department of Nuclear Energy

Related Stories
- IAEA Launches Project to Enhance Leadership and Management Systems for New Nuclear Power Programmes

Related Resources
- Leadership and Management for Safety (GGN Part 2)
- Development and Implementation of a Process-Based Management System
- Project Management in Nuclear Power Plant Construction: Guidelines and Experience
- Management systems
- Integrated management systems for safety and security
- ISO 9001:2015 (International Organization for Standardization)
- ASME NQA-1:2015 (American Society of Mechanical Engineers)

Applying integrated management systems for nuclear facilities and activities leads to more efficient and effective nuclear energy production, participants at a recent IAEA meeting heard.

Workers checking fresh nuclear fuel at the Balakovo Nuclear Power Plant, the Russian Federation.
(Photo: Rosenergoatom)

https://www-pub.iaea.org/books/IAEABooks/11070/Leadership-and-Management-for-Safety
Nuclear Management Systems - NMS Advisor course

PMP certification emerged in the early 1990s. NMS certification will soon be required for nuclear industry management positions. Why not be among the few on the leading edge & be able to demonstrate your BOK in the NMS Advisor profession. We believe Engineers design & keep complex 'technical' safety-related systems running. NMS Advisors design & support maintenance of complex 'administrative' management systems. We now offer an industry first course "Nuclear Management Systems" encompassing 'Concepts, Requirements, Design, Systems Thinking, Integration, Compliance, Effectiveness.' Completion leads to NMS Advisor professional certification.

<table>
<thead>
<tr>
<th>1</th>
<th>1950 ~ 1999</th>
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<tbody>
<tr>
<td>Day 1</td>
<td>U.S. NPP Evolution</td>
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<td>Baseline Requirements</td>
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<td>U.S. Quality</td>
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<td>Quality Affecting Events</td>
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<td>Extreme NPP Accidents - Global</td>
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<td>Nuclear Quality - The Wrong Message 1974</td>
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<td>U.S. Quality Improvement Demand 1980</td>
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<td>Day 2</td>
<td>Quality - Concepts</td>
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<td>Confusion</td>
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<td>Nuclear Quality - Language</td>
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<td>Quality - Basis &amp; Disciplines (QL, QM, QA, QC)</td>
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<td>Terminology - Industry</td>
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<td>Quality - Effective Communications</td>
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<th>1950 ~ 1999 Congressional Report</th>
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<td>Day 2</td>
<td>1984 Report to Congress NUREG-1065 w/ Case Studies</td>
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<td>&quot;Improving Quality &amp; The Assurance of Quality in the Design &amp; Construction of Nuclear Power Plants&quot;</td>
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<td>Whistleblower Provisions</td>
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<td>&quot;The Nuclear Promise&quot; NEI 2015</td>
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Review 2 hours  Written Exam 3 hours  Oral 15+ Minutes
Global Quality Management Advisors

Is Your Nuclear Management System Ready for 2020?