Global Quality Management Advisors

U.S. Nuclear Quality Problems Persist

The Case for Nuclear Management System Advisor | Designer Certification Program

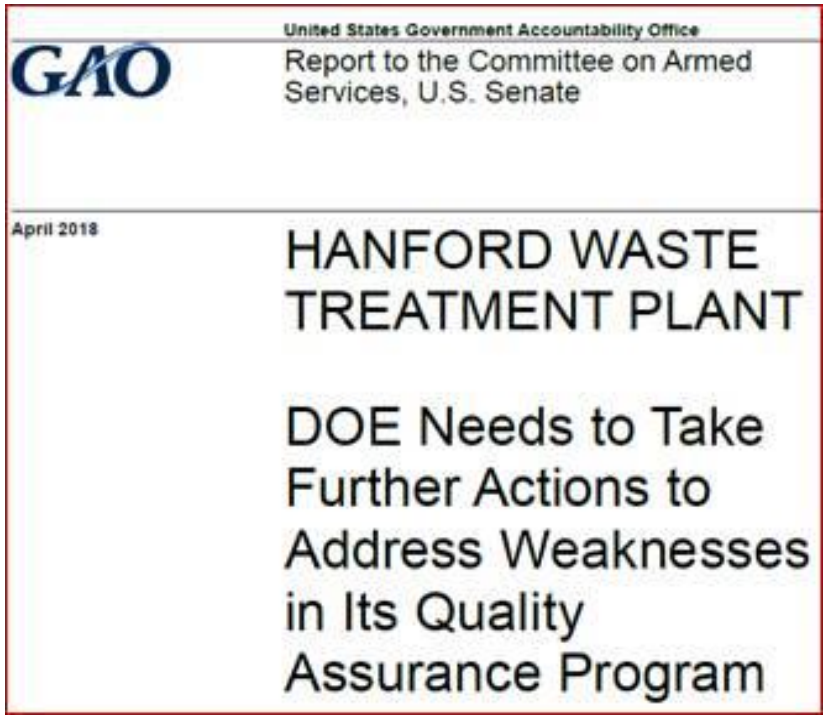
Paul W. Gladieux, Founder | CEO

Quality Assurance Problems - 2018

"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

GQM advisors

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?

Quality & Quality Assurance Problems

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 & Quality Assurance Problems

GQM advisors

Quality

Technical | Administrative

- Where is Quality Taught - Home, Playground, School, Work?
- Is Quality Technical? Is Quality Administrative? Is Quality Complex? Is Quality Confusing?
  - The More Technical the Work, The More Complex the Work & Potential for Confusion
  - 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
- Application - 'The Quality Problem' Continues Because of Poor Language & Perception Provisions

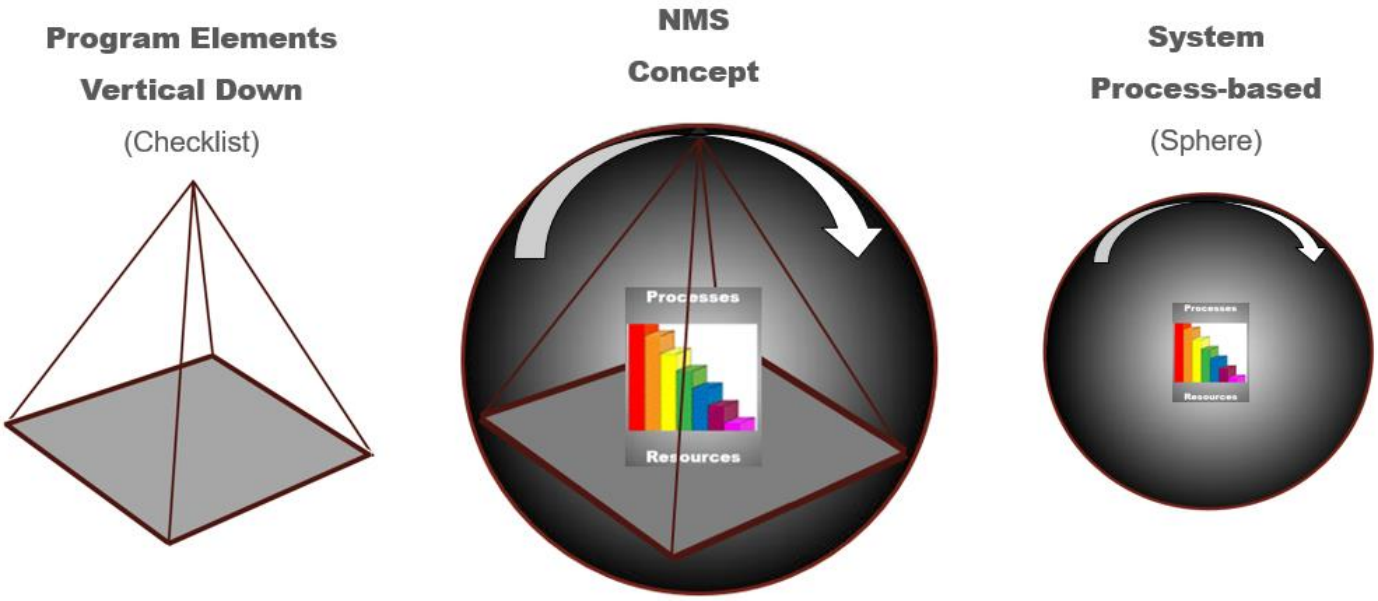
Quality & Quality Assurance Problems

‘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

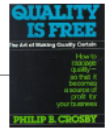
1960 | 1970 | 1980 | 1985 | 1990 | 2000 | 2010 | 2020 | 2030

1979 TMI Accident - Major Design | Build | Knowledge Transfer Gap

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

'Conformance to Requirements'

1979 Concept Emerged



1960 Articles & Books on Quality

1960 Major Emphasis on Quality | Safety

1946 ISO Formed

1971 OSHA Regulations

'Cost of Poor Quality' U.S. Military Supply Chain

1987 Project Management Institute (PMI) Formed

Quality Management Systems (QMS)
- 1987 U.S. Baldrige Performance Excellence (Department of Commerce)
- 1987 ISO 9001 QMS Standards Released

Quality Management Tools
- SixSigma, QFD, FEMA, PDCA, C&E Diagraming, Mapping, Software, Assessments
- 1995 ISO QMS Certified 75K

Enterprise Software
- Intra- & Internet
- CMM Site Wide

Integrated Management Systems (IMS)
- IMS, QMS, EMS, RM, SCM, Others
- Requirements Matrix (Advanced)
- Process Hazards Mgt
- Enterprise Software (Advanced)
- Cyber Security
- Supply Chain Mgt (Advanced)
- Post 911 Safety / Security
- 2006 ISO 9001 QMS Certified .6 million, among 155 Countries

2012 ISO 9001 QMS Certified 1.1 mil, among 178 Countries

ISO 9001 | ISO 19443 N | ISO 14001 | ISO 45001 | Other Management System Certs.

1950 ~ 1999 LNPP Design | Build Period — 65 LNPP Sites & 100 Power Reactors

2000 Renaissance ~ LNPP & SMR NPP

2005 China AP1000 WEC 2 NPP Sites | 4 Reactors

2008 NuScalePower SMR -TBD

1957 IAEA Founded

Requires upgrade to align with advanced understandings in quality management

1950 Complex Engineered Products / Systems

1962 Mil-Q-9858A UK BS-5750

1965 New Codes / Standards

1970 NRC QA Public Law 10CFR50 Appendix B

1971 Industry Standards ANSI N45.2 – 1971 QA ANSI N45.2 – 1977 QA ASME / NQA-1 – 1979 QA

1974 NRC Regulatory Guides

U.S 10CFR50 App B | U.S. Reg Guides | U.S. ASME/NQA-1 | U.S ANS 3.2 | CSA Z299 | IAEA-GS-R3

1984 Marble-Hill Cancelled $3.2 bil

1984 WH Zimmer Cancelled $ 3.4 bil

2018 Vogtle 3 & 4 AP1K Cancel - TBD

2017 VC Summer AP1K Cancelled $9 bil

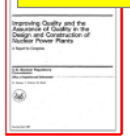
2016 mPower SMR Cancelled $400 mil

1979 Accident Three Mile Island NPP

1986 Accident Chernobyl NPP

2011 Accident Fukushima NPP

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



2001 911 Twin Towers

2010 BP Deepwater Horizon

EMS Shift from "Paperwork"

Culture
Safety
Quality
Security

Quality Control Program

Quality Assurance Program

RG / Code / Standard Upgrades Assessments & Oversight

QA, QC, Test, Supply Chain Management

Quality Engineering, Design Assurance

Quality Management System

Enterprise Management Software

Robotics

Integrated Management System

Cyber Security | AI

1960 QA | 1970 QE | 1980 QM | 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 QMS certification as a part of product / service / system safety-basis certifications.

The U.S. NRC recognized ISO9001:2000 in 2003. 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?

 Paul W. Gladieux, Founder | CEO

GQMadvisors NQM tmln 06-10-17 R3

Knowledge Transfer Gap

Quality Problems - U.S. Industry Failures

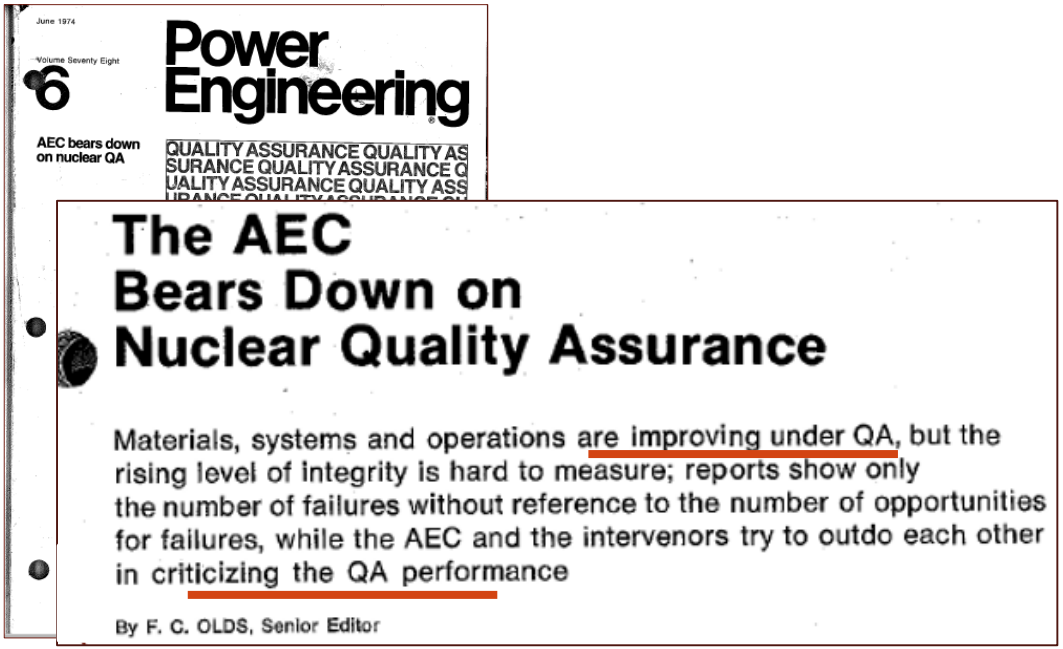
Business Cases 1974 ~ 2018

'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**
- **1984** **U.S. NRC NUREG-1055-1984,** "Improving Quality & The Assurance of Quality in the Design &
  - 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**
- **2018** **U.S. GAO Report 18-241, DOE Hanford Site Waste Treatment Plant (WTP) Washington State**
  - **Quality Assurance Program Failure**

Power Engineering Magazine - June 1974

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



June 1974

Volume Seventy Eight

6

Power Engineering

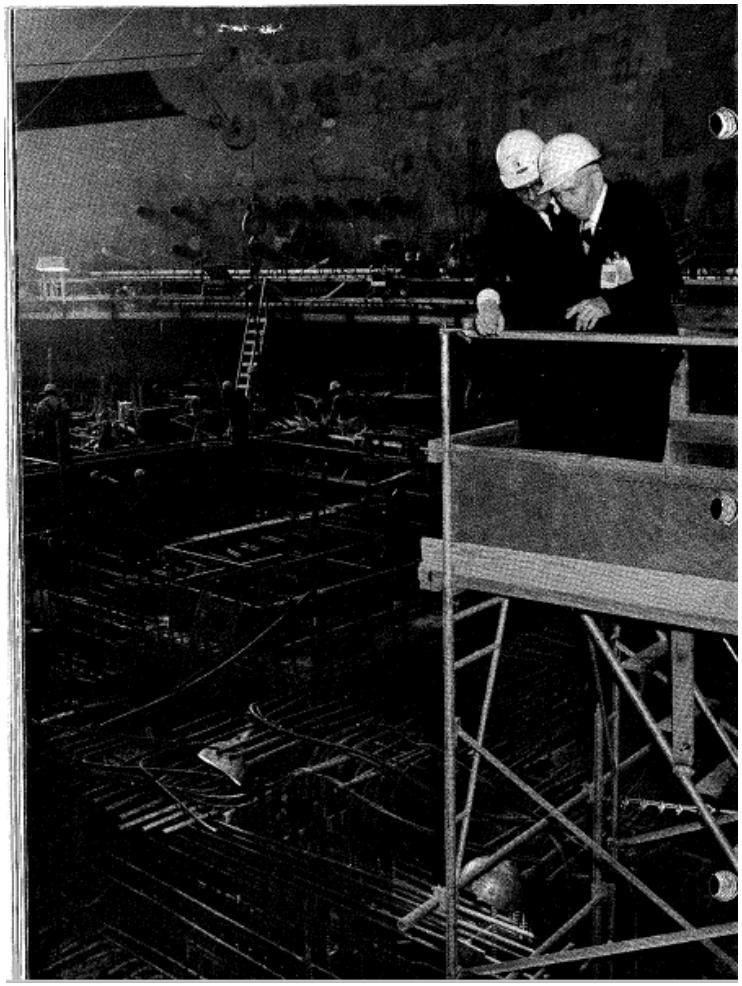
AEC bears down on nuclear QA

QUALITY ASSURANCE QUALITY AS SURANCE QUALITY ASSURANCE Q UALITY ASSURANCE QUALITY ASS

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



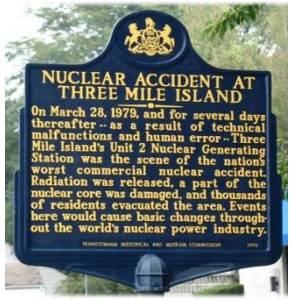
What Do You Think After Reading The Article Title & Then Seeing The Picture?

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.

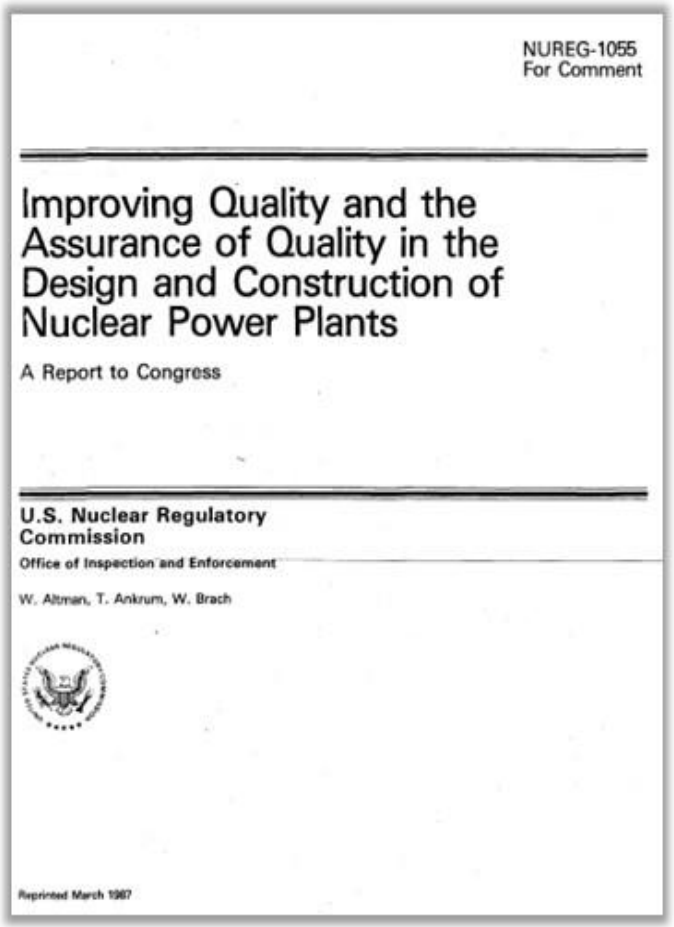
NRC NUREG-1055, March 1984, Improving Quality and the Assurance of Quality in Design and Construction of Nuclear Power Plants.

The report focus is on the "Management of Quality"

Quality Problems - 1984

U.S. NRC NUREG-1055-1984, "Improving Quality & The Assurance of Quality in the Design & - Construction of NPPs" First U.S. Fleet NPPs - **Quality Failures & Successes**

Cancellations driven by 1979 TMI accident Pennsylvania
Zimmer – Ohio
Marble Hill – Indiana


NUREG-1055
For Comment

Improving Quality and the Assurance of Quality in the Design and Construction of Nuclear Power Plants

A Report to Congress

U.S. Nuclear Regulatory Commission

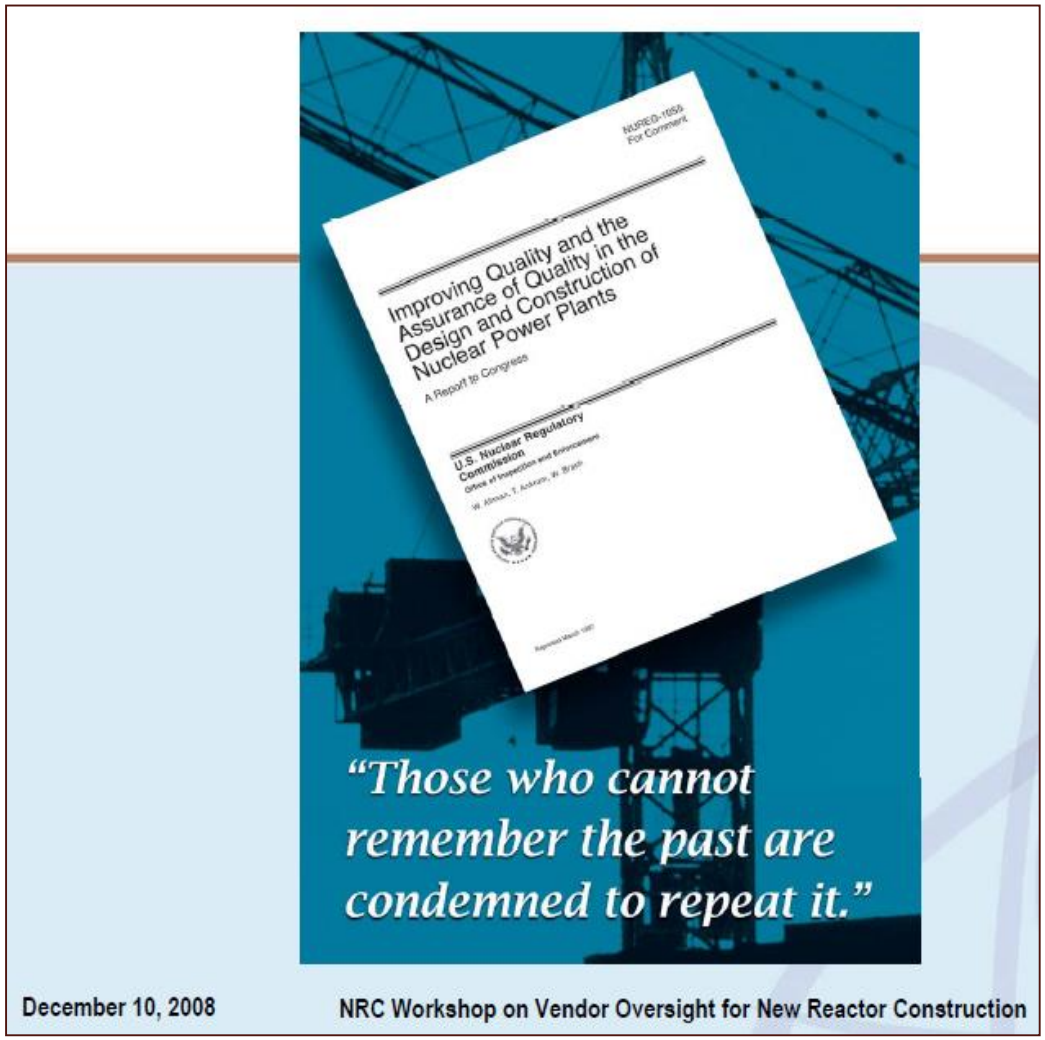
Office of Inspection and Enforcement

W. Altman, T. Ankrum, W. Brach

Reprinted March 1987

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**



Quality Problems - 2009

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

United States Government Accountability Office

GAO

Report to Congressional Requesters

October 2008

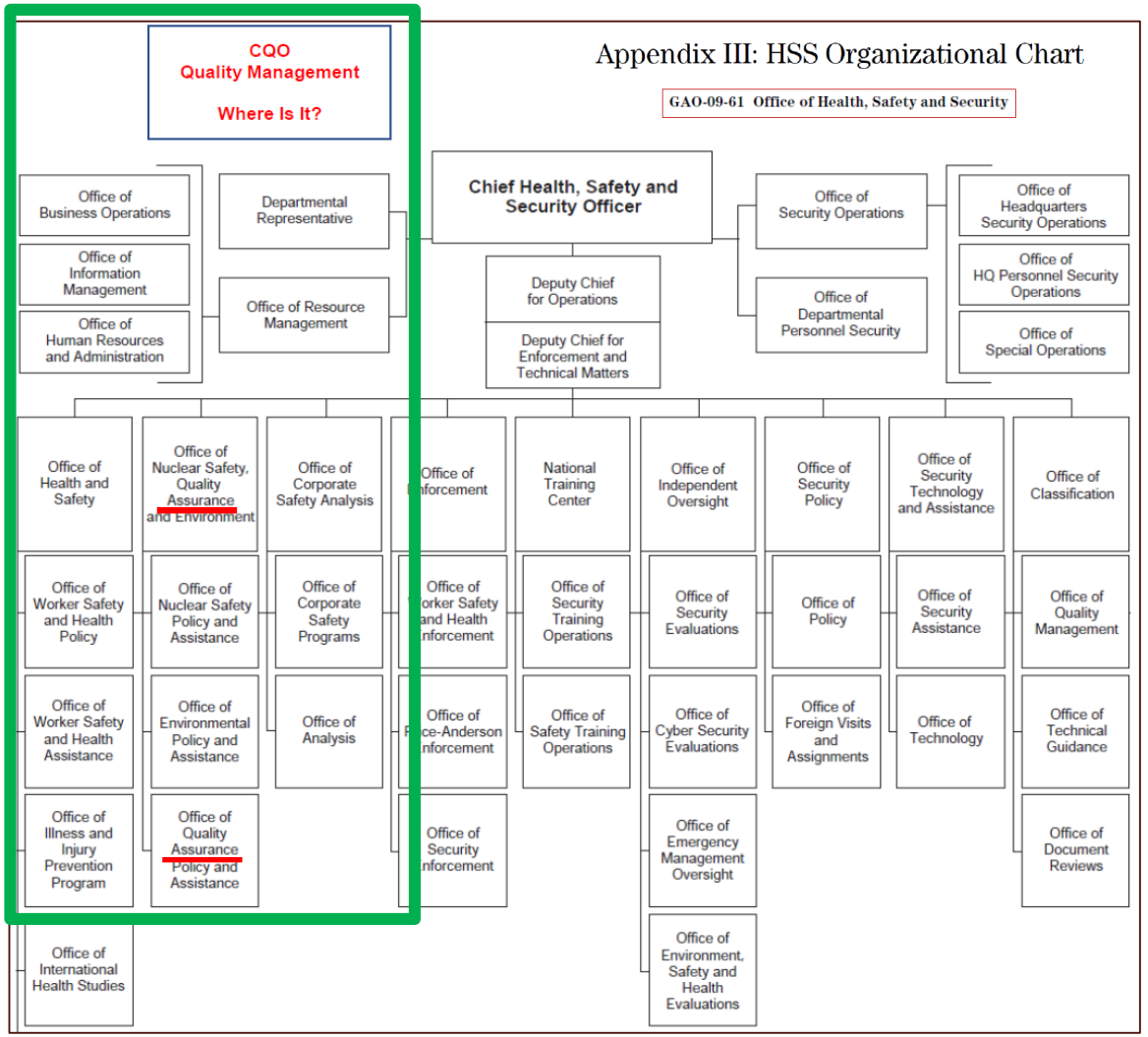
NUCLEAR SAFETY

Department of Energy Needs to Strengthen Its Independent Oversight of Nuclear Facilities and Operations

GAO

Accountability * Integrity * Reliability

GAO-09-61



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

https://www.forbes.com/sites/rodadams/2017/03/13/bechtel-and-bwxt-quietly-terminate-mpower-reactor-project/#1649fee74990

Forbes, March 13, 2017, Rod Adams, contributor

Design Start:	2009
DCA Target:	2013 Original
Last Target:	2017 March, Bechtel Cancelled Program
Cancelled:	2017 March, BWXT Stopped Program

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.

Quality Problems - 2017

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

ENR

U.S. Shaw Nuclear Services

Risk Management

Witness to the Origins of a Huge Nuclear Construction Flop

An inside account from 2010 of events that led to the Westinghouse bankruptcy

Christopher Hartz is an early eyewitness to the twin projects that punctured the hope for a "nuclear renaissance" and drove Westinghouse into bankruptcy.

For 14 tumultuous months, from late 2009 to 2011, Hartz worked for Shaw Nuclear Services, the main subcontractor to Westinghouse on its new Georgia and South Carolina reactor projects. With the South Carolina project now canceled and the Georgia project billions of dollars over budget and years late, Hartz's account of what he saw and experienced in Shaw Nuclear's Charlotte, N.C., office provides a new channel for understanding the traumatic infancy of a slow-developing disaster.

"I wasn't a whistle-blower. I was just a senior procurement manager who was concerned."

– Christopher Hartz, former Shaw Nuclear procurement quality-assurance manager

Looking back, Hartz now sees the incident as a symbol of all that was wrong in Shaw's approach to the projects. "It was a precursor," says Hartz. One of many, as it turned out. To build the first new nuclear reactors in the U.S. in three decades—South Carolina's V.C. Summer Units 2 and 3 and Georgia's Plant Vogtle Units 3 and 4—the design and construction team would face a steep learning curve. However, says Hartz, learning wasn't much of a priority in the rush to start work at Lake Charles. "They were clueless" about the complex geometry of nuclear welds, the nuclear supply chain and the need for a nuclear safety culture, he notes, adding, "I wasn't a whistle-blower. I was just a senior procurement manager who was concerned."

Richard Korman https://www.enr.com/articles/43325-witness-to-the-origins-of-a-huge-nuclear-construction-flop

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

TOP STORY

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.

ANS Nuclear News Article - June 2018

U.S. GAO Report 18-241, DOE Hanford Site Waste Treatment Plant (WTP) Washington State - 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

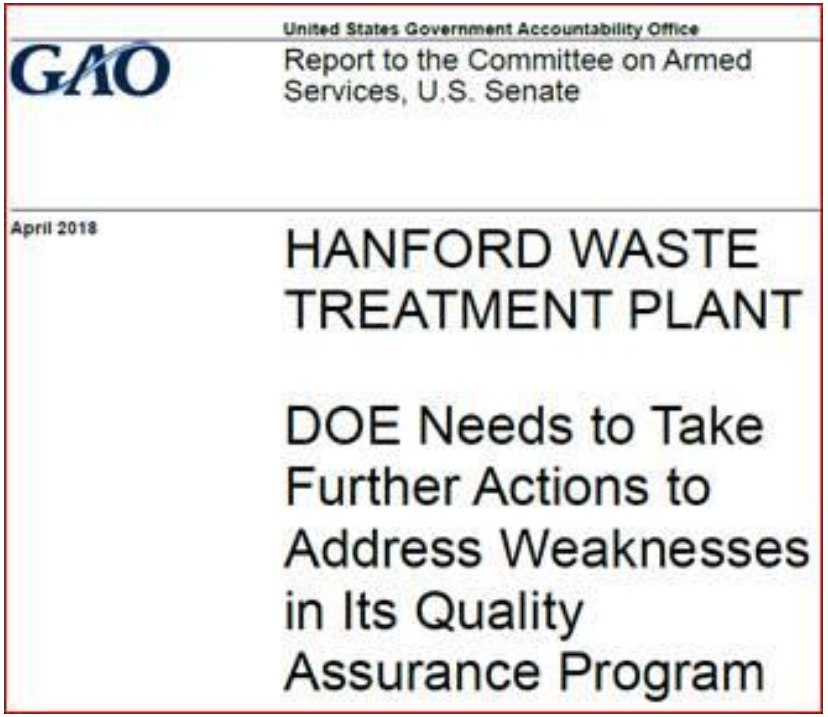
NOTES:

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


United States Government Accountability Office

GAO

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

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.

Page 21

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

Page 24

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

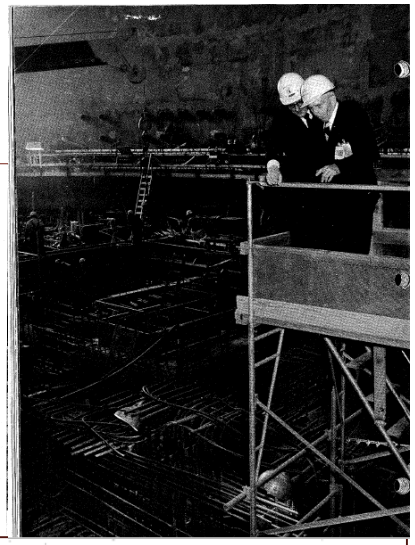
In the commercial nuclear industry, there is a notable example of a construction project that faced significant quality assurance challenges. In the 1970s and early 1980s, Cincinnati Gas & Electric attempted to construct a commercial nuclear power plant, known as the Zimmer Plant, near Moscow, Ohio. After 10 years of construction and more than $2 billion spent, the company abandoned its effort 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

Quality Problems - June 1974 ~ June 2018

1974 - Power Engineering



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By F. C. OLDS, Senior Editor

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2017 - BWXT & Bechtel Terminate mPower SMR Program

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2018 - U.S. GAO DOE

"Quality Assurance Problems Persist at WTP"

United States Government Accountability Office

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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

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

Quality Problems - 1984

U.S. NRC NUREG-1055-1984
Lessons Learned

New Construction - Deficiencies Now

What is being observed in current construction efforts:

- Inadequate QC Documentation
- Inadequate reporting of nonconformances
- Drawing deficiencies
- Inadequate specifications
- Materials control deficiencies
- Inadequate procedures and instructions
- Procedure violations
- Inadequate licensee audits
- Inadequate corrective action program

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

New Construction – NRC Observations

- Vendors inexperienced in nuclear environments
- Industry challenges with Vendor oversight
- Construction craft and contractors inexperienced in nuclear environments
- Difficulty managing multiple design control processes
- Difficulty managing multiple problem identification and resolution (PI&R) programs
- Procurement specification issues – beyond code but not enforcing
- Insufficient QA personnel for oversight activities
- Inconsistent understanding and implementation of NRC requirements
  - Commercial Grade Dedication
  - 10 CFR Part 21

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

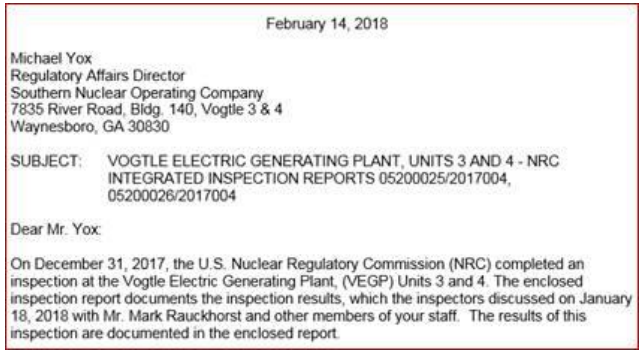
6

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

Focus on Your Management System

Quality Vogtle 3 & 4 - 2018

Quality Management System
Quality Assurance Program



February 14, 2018

Michael Yox
Regulatory Affairs Director
Southern Nuclear Operating Company
7835 River Road, Bldg. 140, Vogtle 3 & 4
Waynesboro, GA 30830

SUBJECT: VOGTLE ELECTRIC GENERATING PLANT, UNITS 3 AND 4 - NRC INTEGRATED INSPECTION REPORTS 05200025/2017004, 05200026/2017004

Dear Mr. Yox:

On December 31, 2017, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at the Vogtle Electric Generating Plant, (VEGP) Units 3 and 4. The enclosed inspection report documents the inspection results, which the inspectors discussed on January 18, 2018 with Mr. Mark Rauckhorst and other members of your staff. The results of this inspection are documented in the enclosed report.

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

Renaissance 2000 ~

1st Design / Build Era

1950 ~ 1985

NPP Design / Build Gap

1969

10CFR50 App B

Nuclear Quality

Gen I

Early Prototypes

- Shippingport
- Dresden
- Magnox

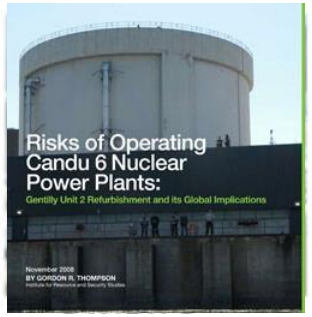
Gen II

Commercial Power

- PWRs
- BWRs
- CANDU

Gen III

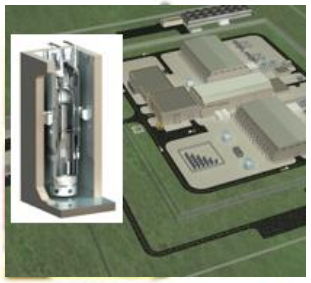
Advanced LWRs



- CANDU 6
- System 80+
- AP600

Gen III+

Evolutionary Designs



- SMR
- AP1000
- AP1000
- ACR1000
- ABWR
- APWR
- ESBWR
- EPR

NuScale Power

Westinghouse

Gen IV

Revolutionary Designs

- Safe
- Sustainable
- Proliferation Resistant & Physically Secure

1950	1960	1970	1980	1990	2000	2010	2020	2030	2040
Gen I		Gen II			Gen III		Gen III+		Gen IV

Workforce - Human Resources

The Dynamic Human Resource Problem

"Cost & scheduling to pre-qualify, train, certify, & knowledge maintenance"

Update of the MIT 2003 Future of Nuclear Power

http://web.mit.edu/nuclearpower/pdf/nuclearpower-update2009.pdf

ANS	2005	50K to Retire 2015
WNN	2015	50K to Retire 2015
NEI	2014	25K to Retire 2016

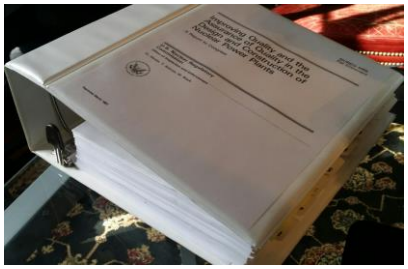
Readiness of the U.S. Nuclear Workforce for 21st Century Challenges

A Report from the APS Panel on Public Affairs Committee on Energy and Environment

June 2008

https://www.aps.org/policy/reports/popa-reports/upload/Nuclear-Readiness-Report-FINAL-2.pdf

U.S. NRC Report to Congress
NUREG-1055-1984
Nuclear Quality Management Failures



"Are We Leveraging from the Past"?

Renaissance 2000

NPP Design / Build Resource Gap

Design / Build

1950 ~ 1985

Operations

NuScale Power

Westinghouse

1950	1960	1970	1980	1990	2000	2010	2020	2030	2040
Gen I			Gen II		Gen III		Gen III+		Gen IV

Workforce - Supply Chain Resources

The Dynamic Supplier Resource Problem

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

American Nuclear Society

Annual Buyers Guide

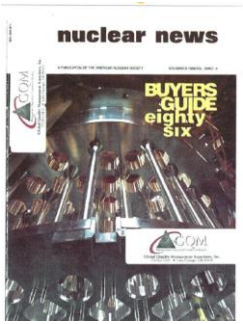
First Gen Design / Build		Renaissance 2000			
	1986	2005	2012	2014	2017
Suppliers	2,260	1,150	1,000	800	850
Categories	500	480	473	465	472

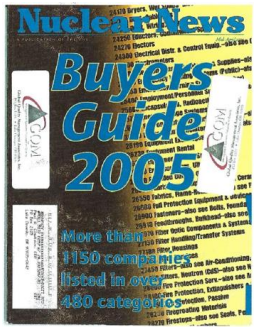
Renaissance 2000
50% Drop in Qualified / Certified Suppliers

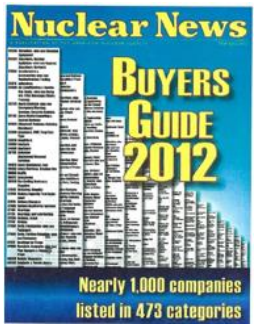
15 Year Supply Chain Resource Gap

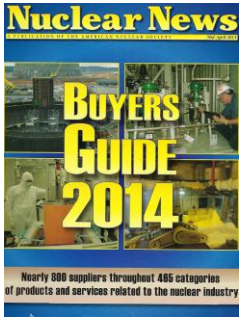
????????

1950









Quality Problems - 1912 ~ 2011

Quality Affecting Significant Events (Examples)	
• 1912	RMS Titanic Atlantic Ocean (UK)
• 1941	World War II Mass Production (U.S.)
• 1955	Post-War Aerospace (U.S.)
• 1955	Naval Nuclear Program (U.S.)
• 1955	Atoms for Peace (Global Effort)
• 1960	Global Space Race (NASA, U.S.)
• 1968	Commercial Nuclear Power (U.S.)
• 1979	TMI Unit 2 (Pennsylvania, U.S.)
• 1984	NRC NUREG-1055 Report to Congress Nuclear Industry Quality / Safety / Management Failures (U.S.)
• 1986	Challenger Shuttle (U.S.)
• 1986	Chernobyl (Russia)
• 1988	Piper Alpha Oil Spill (North Sea)
• 1989	Exxon Valdez Oil Tanker Spill Prince William Sound (Alaska, U.S.)
• 2001	911 (New York City, U.S.)
• 2002	Prestige Oil Spill (Spain)
• 2002	Davis Besse' Reactor Head (Ohio, U.S.)
• 2003	Columbia Shuttle (U.S.)
• 2008	Metrolink Train (Southern CA, U.S.)
• 2008	B2 Bomber Crash (U.S.)
• 2010	Deepwater Horizon BP Oil Spill, Gulf of Mexico, 87 Days, (UK)
• 2011	Fukushima Daiichi (Japan)

Drivers for Improved Quality & Safety

Quality Solutions - International

International Atomic Energy Agency

Integrated Management Systems & Quality Assurance

IAEA International Atomic Energy Agency

Press Centre Employment Contact

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Integrated Management Systems and Quality Assurance Lead to Improved Safety and Business Performance, IAEA Meeting Hears

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

DEC 13 2017

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

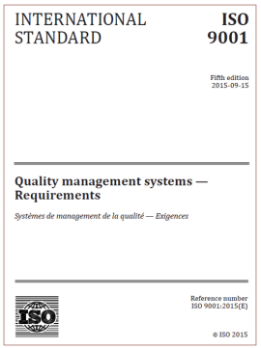
Applying integrated management systems for nuclear facilities and activities leads to more efficient and effective nuclear energy production, participants at a recent IAEA meeting heard.

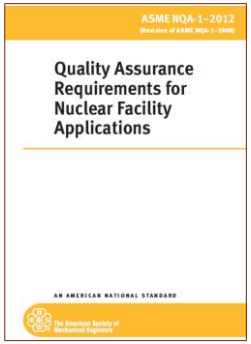
Related Stories

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

Related Resources

- Leadership and Management for Safety (GSR 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





ISO 9001 &

ASME NQA-1

https://www-pub.iaea.org/books/IAEABooks/11070/Leadership-and-Management-for-Safety

https://www.iaea.org/newscenter/news/integrated-management-systems-and-quality-assurance-lead-to-improved-safety-and-business-performance-iaea-meeting-hears

Quality Solutions - NMS Advisors | Designers

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.

1 — Day 1 — **1950 ~ 1999**

- U.S. NPP Evolution
- Baseline Requirements
- U.S. Quality | Safety Evolution
- Quality Affecting Events
- Extreme NPP Accidents - Global
- Nuclear Quality - The Wrong Message 1974
- U.S. Quality Improvement Demand 1980
- Quality - Concepts | Consensus | Confusion | Practice | Communications
- Nuclear Quality - Language | Culture
- Quality - Basis & Disciplines (QL, QM, QA, QC)
- Terminology - Industry | Regulatory
- Quality - Effective Communications

2 — Day 2 — **1950 ~ 1999 Congressional Report**

1984 Report to Congress NUREG-1055 w/ Case Studies
"Improving Quality & The Assurance of Quality in the Design & Construction of Nuclear Power Plants"

3 — Day 2 — **Quality & The Law**

- Regulations
- Safety | Quality Culture
- SCWE | Employee Concern Program
- Whistleblower Provisions

4 — Day 3 — **Renaissance 2000 ~ Readiness** - The Management System

4A	Launch 2000	4E & 4F Sects. 1 & 2	Systems Management	(App B, Crit. 2)
4B	Workforce		Design Management	(App B, Crit. 3)
4C	Informed Management	4G, 4H, 4I	Information Management	(App B, Crit. 6 & 17)
4D	Requirements Management		Supply Management	(App B, 4 & 7)

4 4G, H, I — Day 4 — **Industry 2020 ~ Readiness**

- "The Nuclear Promise" NEI 2015
- Young Professionals
- U.S. Government Actions
- Advancements - 2020
- Status - 2020
- Management Thought Leaders

5 — Day 5 — Review 2 hours — Written Exam 3 hours — Oral 15+ Minutes

GQM advisors

5 Parts

5 Days

Contents ←

Day 5
5 hours
Review
Exam

Global Quality Management Advisors

California	North Carolina	Texas	Washington
Georgia	Oregon	Utah	Washington, DC
Nevada	Tennessee	Virginia	

Now in The United Kingdom

Is Your Nuclear Management System Ready for 2020?

https://gqmadvisors.com/wp-contentuploads/2016/08/GQM_updatedAudio.mp4?_=1