World Nuclear Association

DESIGN CHANGE MANAGEMENT

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Design change management

- It's a fundamental element of how we organise ourselves to maintain safety
- It affects plant standardisation and maintenance over a 60-80 year life
- It starts during licensing and construction
- Fukushima illustrated deficiencies

Agenda

- What is the Problem?
- WNA / CORDEL / Design Change Management Task Force
- Vendor Role
- Owners' Group Role
- Utility Role and Design Authority
- WANO Role
- Regulator Role
- Conclusions/Questions

Design Change Happens! Or fails to happen!

- In 60-80 yrs NPP lifetime, safety-related design and operating changes are driven by:
  - New analysis insights, OPEX, PSR, PRA, obsolescence….
  - Changes in regulatory and licensing requirements
  - Power upgrades
- Management objectives and values may change
- Originally standardized reactors become unique
- Potential safety drawbacks

Current Situation – Is there a Problem?

Complex, unique infrastructure

Nature of nuclear power plant design and construction involves many players:

- Architect-engineers - Operator - Owner
- Nuclear island designer - Balance of plant designers

Creating a large, complex and **quite often unique** infrastructure and **design**

Sole responsibility with the licensee

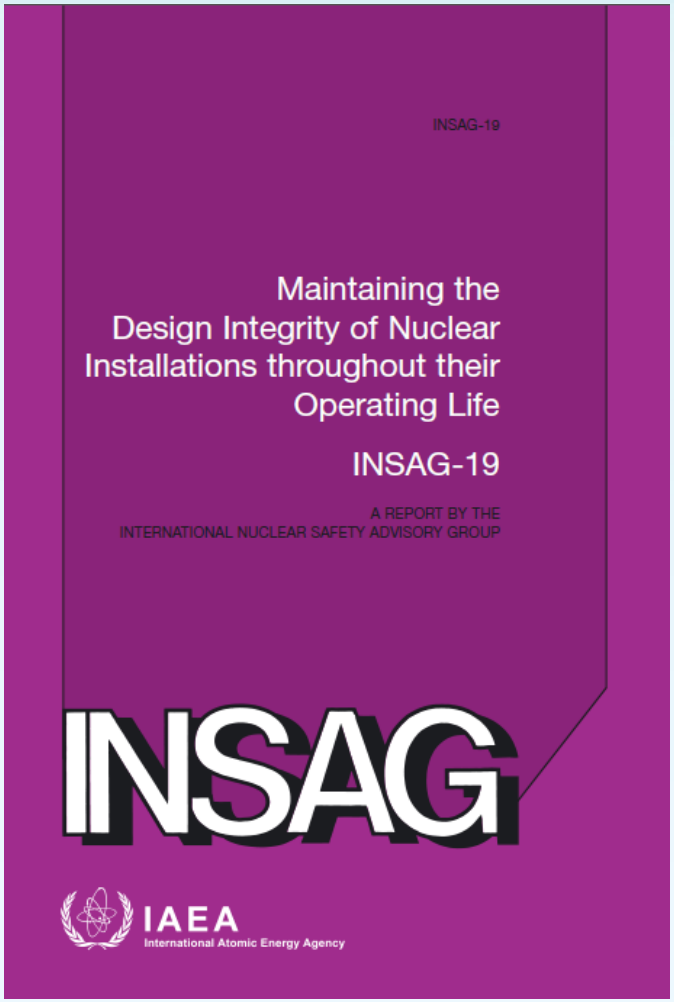
Current nuclear industry legal and regulatory framework

- Holds every **licensee** solely responsible for safety of design and operation
- Expects every **licensee** to maintain a full understanding and knowledge of design within licensee's own organisation in an internal entity called 'Design Authority'

Current Situation – Is there a Problem?

- **Is this working well?**
  - Works for large utilities with strong technical staff
  - May be barely tenable for smaller utilities today- who require much support from others
- **May be untenable for small utilities running turnkey Gen III reactors in future**
- We encourage regulators to re-examine this expectation

How to Implement INSAG 19?



- **With New Build in Mind**
- **Fleet wise / Fleet wide**
- **During 60+ years life span**

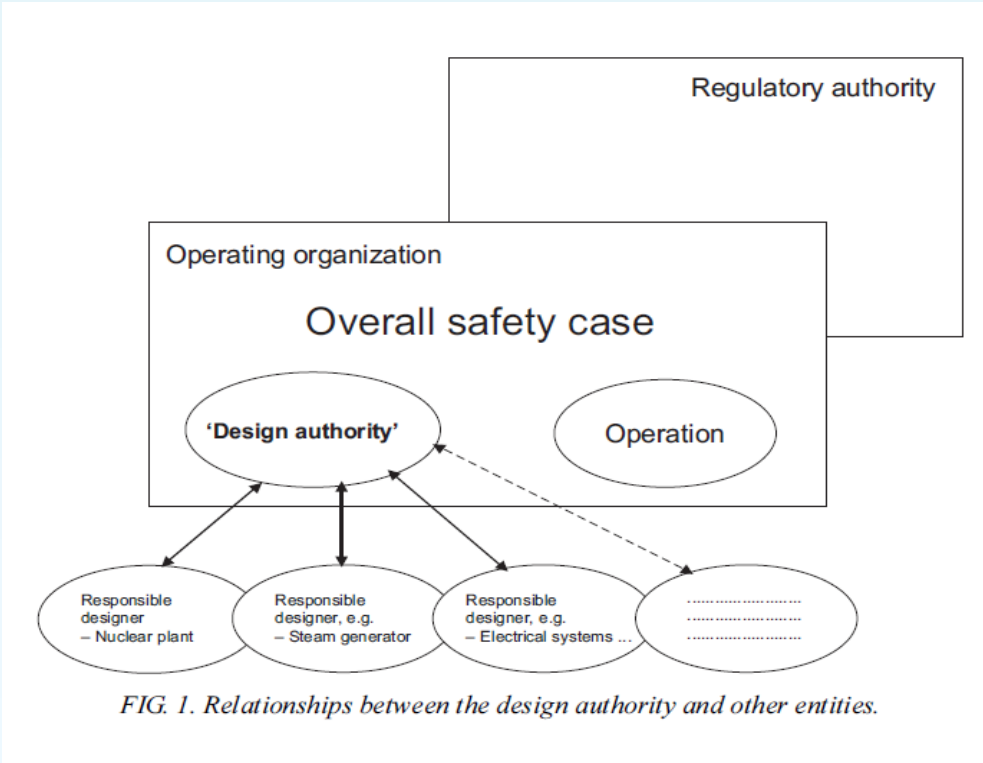


FIG. 1. Relationships between the design authority and other entities.

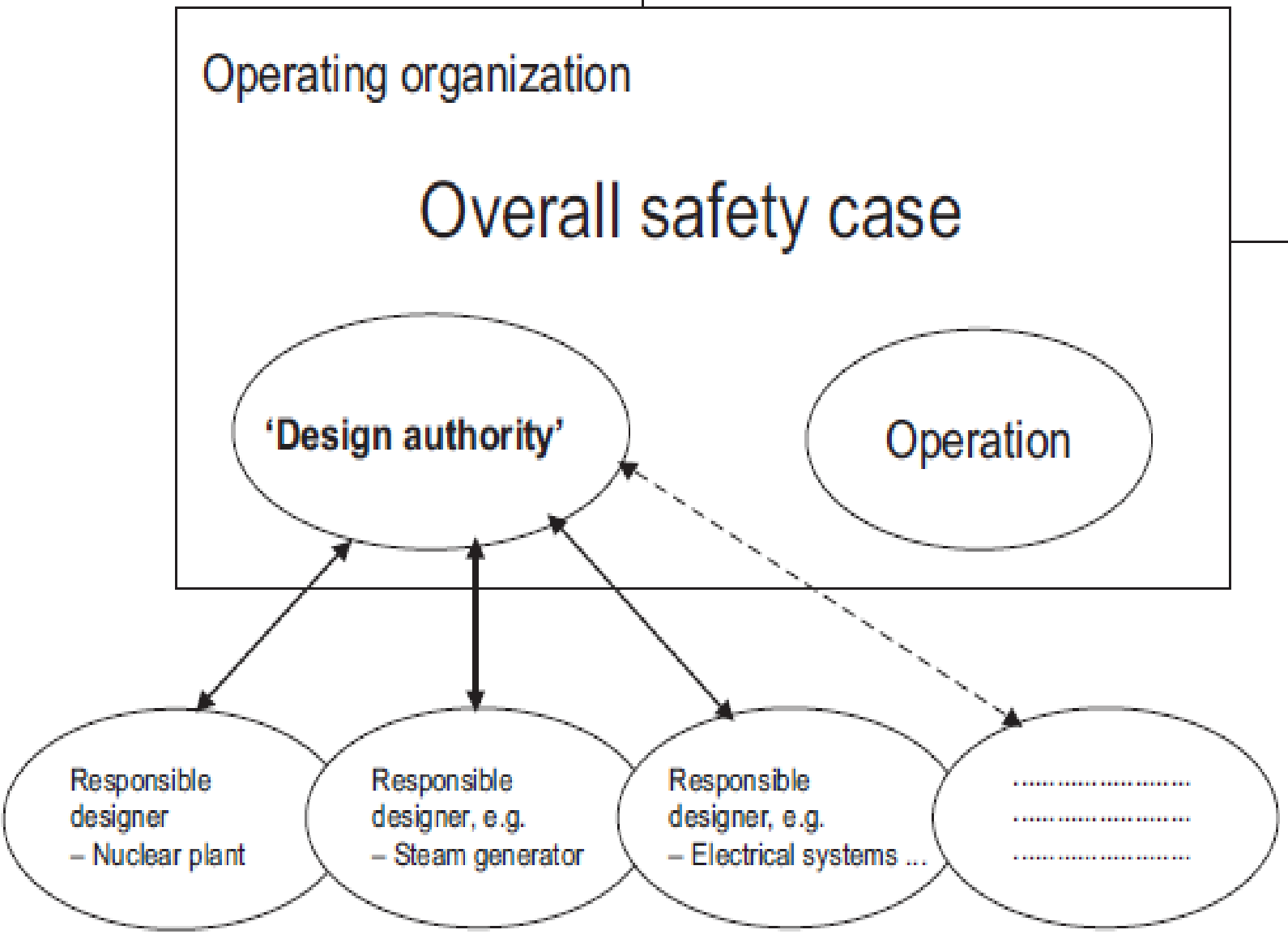


FIG. 1. Relationships between the design authority and other entities.

Design Change : Is there a problem

- **Design authority:**

To deal with design changes from all sources requires:

Why the plant looks like it does, original design calculations, research basis, mathematical models, safety analysis assumptions, safety analysis codes, inspections, OPEX information from many sources ….

A high level of understanding

- **INSAG 19: "Huge amount of data"**

- **Responsibility met by many different combinations of:**
  - In-house expertise
  - arrangements with original designers
  - Owners' Groups
  - others

Design Change : Is there a problem?

Current plant:

- Works for large utilities with strong technical staff
- Loss of capability in large utilities that don't build for a long period and reduce design staff?
- Small utilities with one or two units: have knowledge to operate safely
- May have little in-house expertise for design change
- Heavy reliance on original vendors, Owners' Groups, INPO, but no consistent, defined role
- We encourage regulators to re-examine this expectation

Design change- is there a problem?

Fukushima evidence:

- The progression and consequences of prolonged station blackout were understood in 1989
- The Fukushima vent design was not adequate in SBO state
- Vents not designed to deal with hydrogen (not required by regulators - though hydrogen is expected in core melt)
- Design of hardened vents in BWRs were all different
- USNRC: each design "would have different operational complexities" during a prolonged SBO scenario
- Was this an optimum design change process?

Design Change : Is there a problem?

New build:

- **Small utilities running turnkey Gen III reactors in future will have great difficulty in meeting DA expectation**
- CDF and large release frequency -factor of 10 down = more events to analyse, more complex safety case, more understanding needed
- Expectation that all utilities will have large design staff to maintain full design authority knowledge … **not realistic**
- Expectation that every utility will maintain full OPEX of all similar plants dubious
- Periodic safety review will bring more design changes – from different countries operating the same reactor

We encourage regulators to re-examine this expectation

Institutional contributions

Real accidents: major contributors to failure are human and institutional performance - in **all** highly regulated industries

- ✓ *In aircraft industry, contribution about 85%*
- ✓ *In nuclear, contribution around 70-90% of the risk of a serious accident*
- ✓ *Design / engineering issues contribute 10-30%*

If new build is to achieve factor of 10 reduction in severe accident rate, institutional failure rate also needs reducing by factor 10

Aircraft industry experience- factor 2 was difficult to achieve !

Standardisation = better safety

- Organisation weaknesses were contributors to Fukushima – and NOT JUST IN JAPAN
- High reliability achieved through learning from each other
- Standardisation brings easier learning
- Organisational barriers to learning should be avoided
- To achieve factor 10 lower CDF needs big improvements in how we **organise** ourselves - as well as better design
- Aircraft industry looked for factor of 2 reduction in accidents- recognised need for **organisational** changes (SMS)

What organisational changes should we be thinking about?

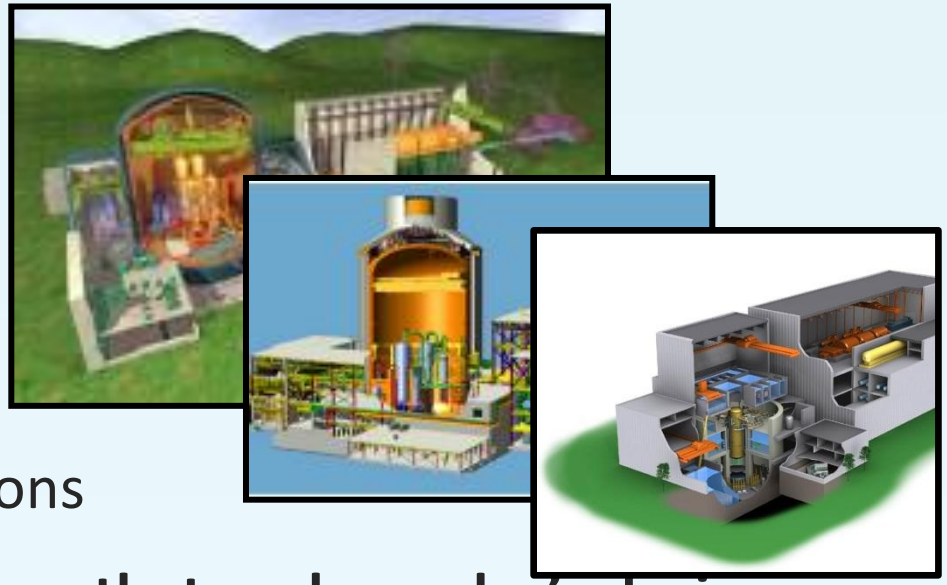
Organisational changes?

- Recognition by regulators of benefits of standardisation - **throughout life**
- Avoid divergence of systems important to safety at licensing
- Agreement on implementation of INSAG 19
- Design certification: Agreements between national regulators?
- Maintenance of design knowledge across a fleet?
- Prevention of design divergence over 80 year plant life?
- Recognition of the role of the designer through plant life?
- Fleet implementation of design changes - EDF experience?

The CORDEL Working Group

Founded in January 2007

- Main aim: promoting international standardization
- Membership:
  - all major vendors
  - utilities interested in new build
  - service companies
  - observers from int'l organisations



International standardization means that each vendor's design can be built by a vendor, and ordered by a utility, in every country and be able to meet national regulations without significant changes other than adaptations to meet site requirements.

Design Change Management Task Force

The Case for Standardisation

- Will reduce build costs
- Will reduce licensing/financial uncertainty
- Will improve reactor safety in operation

Mandate for DCM Task Force

- To develop institutional mechanisms in the industry to enable compliance with standardization throughout standard fleet's lifetime

Research

Institutional change takes time! CORDEL also looks for opportunities for short and medium term changes

- Survey of Owners Groups and Utility discussions
- Design Authority role survey
- Discussions with the Aerospace Industry
- World Association of Nuclear Operators (WANO) discussions
- Regulator (MDEP) discussions
- Standards Organisations

Owners' groups may be key institutions

Owners' Group Survey

6 large Owners' Groups involved:

- AREVA Owners Group (formerly Framatome Owners Group)
- OKB Gidropress (Russian NSSS vendor)
- Candu Owners Group
- PWR Owners Group (USA and International)
- Japan PWR Owners Group
- Boiling Water Reactor Owners Group (BWROG)

Questions:

- Number of Members
- Mandatory vs voluntary membership
- Charter of organization
- Areas of Activity
- OPEX exchange
- Library of licensing and safety issues
- OG accountabilities for:
  - design and analysis
  - configuration management
  - change management

OG Survey – Key Issues

Results

- OGs work in different circumstances, affecting role/activity
- Vendor's level of involvement variable
- Voluntary membership in most cases but some mandatory
- All share OPEX, safety, reliability, regulatory issues
- Some shared R&D, design, analysis – but no OG accountability

Potential Developments for OGs

- Increased influence/pressure for standardisation
- Strengthened vendor involvement
- Strengthened use of vendor Service and Advisory Bulletins
- Reliability data and PSA
- OG Best Practice Guide

Further discussions needed

Design Authority Survey

Initial survey carried out:

- How is design knowledge acquired and maintained over the life of the plant?
- How is design authority executed?
- What is the role of the original designer?
- What are the DA accountabilities for design change and configuration management?
- How does the DA ensure fleet wide conformance?
- How many Full Time Equivalent staff are in the DA organization?

Korea
France
USA
Canada
UK

Design Authority Survey – Some Results

Large state-owned utilities

- DA with formal arrangements with original designer ("Responsible Designer", "Design Agency")
- Repeat projects develop Utility DA capability
- DA senior voice
- Transfer /development of knowledge -"Book of Knowledge";
- OG support, incorporation of international feedback during PSR

Medium-size privately-owned utilities

- Original designer dependence recognised
- Vendors and OGs have developed design changes but with differing implementation by operators
- Development of internal DA has some problems

What about Small Utilities?

Utility and Design Authority Summary

- **Many utility situations**
  - **Large state-owned, medium privately-owned, operating across different countries, small, single country / plant**
- **But ultimate responsibility for safety / design remains**
- **Clarity is required of how Design Authority (DA) is managed for all situations including:**
  - **relationship with and roles of the original designer**
  - **Independence of DA within organisation**
  - **Transfer and extent of design knowledge**
  - **Development of design knowledge**

Obligatory Utility involvement in OGs should be considered

WANO Role

- WANO provides a unique tool for improving performance and safety of operating plants through its operating experience program
  - SOERs and SERs widely distributed among its members extensively used by most operators.
- But very few links between WANO and vendors.
  - vendor should receive the event report as a rule.
- Vendor could make use of WANO analysis and propose a common solution to customers
- WANO is developing reliability data bases - Vendors' access to relevant areas of this information would help improve their PRA quality for the overall benefit of safety.

Regulator Role (1)

- Multinational Design Evaluation Programme (MDEP) continues past first licensing
- CORDEL roadmap postulates the achievement of joint or coordinated certification
  - Safety documentation could be distributed in two or three tiers
    - many obstacles including sovereignty issues,
    - but the industry should continue to encourage progress in this direction.
- Concept of Regulator "Owner's" Groups
  - Multiple regulators meet periodically and share operating and regulatory experiences with a common design.

Regulator Role (2)

Some actions can be undertaken now.

- Task forces and workshops for technical problems e.g. sump clogging issue
- Life extension common approach
- Periodic Safety Reviews (PSRs) requirement to include adherence to **approved** vendor's safety-related recommendations and to include international experience feedback.
- Regulators require membership in OGs? Compliance with OGs recommendations? Compliance with "Service Bulletins" issued by vendors, **based on a graded approach** in relation to safety importance?

Conclusions and Recommendations (1)

- **Adherence to the standard design is a vital concept that can bring significant benefits to safety and economics of nuclear power.**
- **Original designer must be involved in the management of design changes (particularly new build)**
- **Internationally agreed mechanisms for design change are needed**
- **Owners' Group role is vital and should be enhanced -**
  - joint review and peer pressure
  - Best practice guide
  - Potential role if vendor "disappears"
- **Formation and maintenance of a Regulator's "Owners" Group is recommended.**

Conclusions and Recommendations (2)

- **Reactor vendors should publish "Service Bulletins" on design changes**
  - use of these bulletins needs strengthening
  - should be considered mandatory, (based on safety significance)
- **WANO interaction with vendors should be strengthened.**
- **Utility – vendor relationships and Design Authority concept is vital to achieve design standardisation and improve safety.**
- **Formal, agreed (internationally) role for the designer to play throughout plant and fleet lifetime.**
- **Continue discussions and learn lessons from Aerospace Industry**

Quote from INSAG chair to IAEA DG re: Fukushima Accident

- "…The operator must have engineering, financial and management capability to ensure not only that the plant is built and operated in a safe fashion, but also operates with safety as the highest priority…"Richard Meserve – 07/26/11 to IAEA DG Amano
- However, the operator as the Design Authority must be able to effectively engage larger groups of expertise such as the original vendor(s) and owner groups to take advantage of the collective R and D, OPEX and insights when making design and operating changes to their plants.

Thank you for listening

Questions?