Independent safety engineering in support of the Design Authority

David Boath
Vice President / Chief Engineer, AMEC
AMEC at a Glance

- UK listed
- Revenues ~ £4 billion
- Employees ~27,000
- Working in Around 40 countries

AMEC is one of the world’s leading engineering, project management and consultancy companies

*2013 full year results

We design, deliver & maintain strategic assets for our customers, offering services which extend from environmental and front-end engineering design before the start of a project to decommissioning at the end of an asset’s life
AMEC Nuclear Pedigree

...3,000 nuclear professionals... a Nuclear New Build partner for 60 yrs...

... a strategic role on every civil NPP ever built in the UK...

... a growing international presence...
IAEA Fundamental Safety Principle 1

- “The prime responsibility for safety must rest with the person or organisation responsible for facilities and activities that give rise to radiation risks.”

- 3.5 The licensee retains the prime responsibility for safety throughout the lifetime of facilities and activities, and this responsibility cannot be delegated. Other groups, such as designers, manufacturers and constructors, employers, contractors, and consignors and carriers, also have legal, professional or functional responsibilities with regard to safety.
“The prime responsibility for safety must rest with the person or organisation responsible for facilities and activities that give rise to radiation risks.”

3.6 The licensee is responsible for:
- Establishing and maintaining the necessary competences;
- Providing adequate training and information;
- Establishing procedures and arrangements to maintain safety under all conditions;
- Verifying appropriate design and the adequate quality of facilities and activities and of their associated equipment;
- Ensuring the safe control of all radioactive material that is used, produced, stored or transported;
- Ensuring the safe control of all radioactive waste that is generated.
Regulator’s expectations

- “The licensee shall retain primary responsibility for the safety of its licensed facility, including responsibility for those activities of contractors and subcontractors which might affect safety.”

- “The regulatory body should, through its regulatory activities, provide assurance that the licensee meets its responsibilities for the safety of its facility. This includes assuring that the licensee provides the appropriate level of oversight of all contractors and subcontractors, commensurate with the safety significance of the activity.”
Regulator’s expectations

“It is essential that the licensee retains the capability to be:

• The “controlling mind” of those core activities for which the licence has been granted. Ceding that control to other parties would not be consistent with the principle that the licensee retains primary responsibility for safety.

• The “design authority” which understands the basis of the safety case, and the significance of ensuring that all activities are designed so as to keep the facility within the boundaries of the safety case.

• An “intelligent customer” or “smart buyer” for the goods and services being procured.
Design authority

“11. An operating organization must set up internally a formal process to maintain the design integrity as soon as it takes control of the plant. This may be achieved by setting up a design capability within the operating organization, or by having a formal external relationship with the original design organizations or their successors. There must be a formally designated entity within the operating company that takes responsibility for this process. This entity needs to formally approve all design changes. To do this, it must have sufficient knowledge of the design and of the overall basis for safety. In addition, it must have access through a formal process to all the underlying design knowledge to ensure that the original intent of the design is maintained.”
UK regulatory approach to Design Authority

- **Design Authority** – the defined function of a licensee’s organisation with the responsibility for, and the requisite knowledge to maintain the design integrity and the overall basis for safety of its nuclear facilities throughout the full lifecycle of those facilities. Design Authority relates to the attributes of an organisation rather than the capabilities of individual post holders.

- **Responsible Designer(s)** – organisations which have a formal responsibility for maintaining detailed, specialised knowledge of all the systems and components important to safety, and a core capability in the detailed design process.
The design authority may assign responsibility for the design of specific parts of the plant to other organisations, known as responsible designers.
Design knowledge required

The Design Authority should have the following knowledge:

- A detailed understanding of why the design is as it is with knowledge of the underpinning experimental/research programme
- The design inputs such as basic functional requirements, performance requirements, safety goals and safety principles
- The applicable codes, standards and regulatory requirements, design conditions, loads such as seismic loads, interface requirements etc
- The design outputs such as specifications, design limits, operating limits, safety limits, failure or fitness for service criteria
- A detailed knowledge of the design calculations which demonstrate the adequacy of the design
- An understanding of the inspections, analysis, testing, computer code validation and acceptance criteria used by the plant designer to verify that the design output meets the design requirements
- The assumptions made in all the steps above, including assumptions related to operating modes or procedures and expected life history
- The implications of operating experience on the design
Increasing demands on safety documentation

- 10,000 -
- 5,000 -
- 1,000 -

No of safety related documents

- Windscale
- Chernobyl
- TMI
- Fukushima

1960s Magnox
1970s AGR
1980s AGR PWR
1990s PWR
2000+

Standardisation /Harmonisation
CORDEL Roadmap

“Internationalisation” of DESIGN APPROVAL process

Phase 1. Sharing design reviews and assessments

Phase 2. Validating and accepting design approvals of other countries

Phase 3. Issuing international design certification
Some challenges for owners

- Future vendor status

- Limits on in-house capability (existing nuclear operator):
  - loss of expertise, ageing of personnel with key experience
  - stretch due to large concurrent programmes; plant life extension/ upgrade especially with planned new build
  - increasing demands from licensing authority; greater volume and complexity of documents
  - potential impact on design authority/ intelligent customer capability

- For future licensees with no or very limited experience of nuclear power plant operation:
  - recruitment,
  - safety culture and reliance on NPP designers/ supply chain
  - technology challenges
  - Regulatory regime / international implications

- Maintaining and/ or increasing competition to reduce risk
  - quality, budget and schedule

- Access to expert nuclear services with global experience increasingly important for world leading performance
Whatever the approach, the client and the extended supply chain need to be truly intelligent customers and intelligent deliverers across critical core nuclear skill-sets.
Open Questions - determining operating model and support requirements

- What is the best contracting model?
  - *Does “best” mean *most certain*...*
  - ...or *lowest construction cost*...
  - ...or *lowest overnight capital* cost...
  - ...or *lowest through-life cost*...
  - ...or *least risk*......and who for
  - ... or *most skills transfer*... or...?

- How much work can be done locally?
- What information does the public need and when?
- How much knowledge must the owner have and how much can the plant designer be relied on?
Example resourcing for new build

Flexibility to service each step of the project lifecycle

- Feasibility / Site Selection
- FEED / Specification
- Engineering
- Procurement
- Construction
- Commissioning
- Operations

EPC resources

Thin Design Authority

Thick Design Authority

NNB support resources
Strategic and Technical support

- Site Licence
  - Limited work permit & Construction Licence
  - Oversight during construction
  - Operating Licence

- Planning and Consenting
  - Plant and site selection by utility
    - Nuclear Organisation /QA
    - Plant design & CSJs
    - Safety analyses
    - Conceptual or Generic design
    - Implementation requirements

- Preparations for operation
  - Project and quality management
    - Technical solutions
      - Buildings
      - Systems
      - Structures
      - Components
    - Verification and validation
      - Reviews
      - Analyses
      - Testing
      - Inspections

- Design bases OK
- Implementation OK
- Plant OK
Benefits of nuclear consultancy support

- Pool of suitably qualified expertise across nuclear skill-sets, including niche skills
- Independent of NPP designer; verification, peer review, independent assessment
- Innovation due to wider experience; global projects, other sectors
- Reference capability and projects check
- Greater certainty on cost & schedule outcomes
- Resource planning benefits
- Allows licensee to focus on building or maintaining design authority / intelligent customer key roles
Insights on the benefits of the right nuclear consultancy support

- Understanding and managing regulatory expectations is the first essential
- Ensure country context is fully incorporated
- Understand the intelligent customer relationship early on to plan an effective organisational trajectory
- The design of the Intelligent Customer relationships is key
- The supply chain are crucial in developing technical knowledge transfer
- The procurement strategy must allow for the access to the relevant IPR at the right time
- The transfer of Design Authority experience takes time
- There is never enough SQEPs available to recruit directly
- It's important that global and local suppliers are embedded into the technical support infrastructure to give lasting legacy in operations
Nuclear power plant experience

Bringing assurance and confidence, AMEC employs over 3,000 nuclear specialists and has nearly 60 years of civil nuclear power plant development experience.

AMEC operates in a spectrum of roles in nuclear power plant development.

Whatever the procurement strategy, regardless of reactor technology, AMEC has a proven track record of flexibly delivering discrete services and integrated support.

Mission-critical nuclear power plant services across three core skill-sets

An industry leading employer AMEC provides personnel with unique experience of the nuclear power plant asset.

As well as key personnel support, AMEC deliver integrated solutions by bringing together these three core skill-sets as a combined offering.