Licensing of New Build Reactors in the UK – Part 1

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New Build Reactors in the UK – the EPR

40 EPR units could supply 100% of UK demand

EPR Nuclear Steam Supply System (NSSS)
EPR and the UK GDA Process

- EPR is Generation 3+ PWR design - evolutionary development of the most modern French and German PWRs (N4 and Konvoi designs). UK EPR output = 1650MW(e). One unit = 3.5% UK Electricity Demand.

- EDF and AREVA submitted the UK EPR design to the UK Regulators for “Generic Design Assessment (GDA)” in 2007. GDA Design Acceptance granted in 2012.

- UK EPR is the only reactor design to achieve GDA Design Acceptance so far. Process just started for ABWR

- EDF-led consortium plans to construct 2 EPR units at Hinkley Point. May be followed by 2 units at Sizewell.

- Detailed ‘site specific’ safety report still needed by UK regulators before start of reactor construction

Flamanville 3 – UK EPR Prototype – September 2013
Nuclear Energy: Role of Safety Authority

- Safety Authorities are national governmental organisations, usually reporting to a government Ministry or Department
- In most countries the SA is supported by a dedicated Technical Support Organisation who help define design and operational safety principles and review submissions from license applicants
- Oversight committee of independent experts often used to advise SA on complex safety issues (GPR in France, RSK in Germany, ACRS in US)
- Safety Authority role:
  - To devise rules for the safe design and operation of nuclear plants
  - To assess design and safety documentation to confirm that rules and quality standards have been correctly applied
  - To grant authorisation for construction, fuel load and plant operation of new plants
  - To monitor construction and operation, to show that design and operating rules are being complied with. To approve safety significant modifications to physical plant or operating procedures.
**Safety Authority – French Model**

- Ministries of Industry & Environment

  - GPR (Advisory body)

  - ASN
    - Regulation of operating reactors
    - New build licensing

  - IRSN
    - Research on radiation risk and environmental pollution
    - Advisor to ASN
    - Consulted but separated from ASN

**Safety Authority – US Model**

- USNRC - Commissioners

  - ACRS (Advisory body)

  - Director of Operations

  - Deputy Executive Director for Reactor and Preparedness Programs
    - Regulation of operating reactors
    - New build licensing

  - Deputy Executive Director for Materials, Waste, Research, State, Tribal and Compliance Programs
    - Scientific/technical support and reactor safety research
    - Environment management
    - Safeguards
UK Approach to Regulation of Civil Nuclear Industry

- Very limited specific UK legislation exists relating to design, construction and operation of nuclear installations
- UK regulatory approach based on PRINCIPLES & GOALS rather than LEGALLY ENFORCABLE REGULATIONS as used in countries such as France and US
- Principle of ALARP overrides other requirements
- Licensees expected to develop own principles/rules/guidelines for design, construction, operation and decommissioning of their facilities
- HSE/ONR is small regulator by international standards (~220 inspectors) with no dedicated Technical Support Organisation. Its role is to approve licensee’s own rules and to monitor compliance
- ONR has developed Safety Assessment Principles (SAPs) for assessing licensee submissions relating to nuclear safety
HSE/ONR Safety Assessment Principles (SAPs)

Contents of HSE/ONR SAPs (1/2)

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SAPs Discussion

- SAPs are often detailed and may be demanding. In many cases wording is open to different interpretations.
- SAPs may be interpreted differently by different ONR inspectors.
- SAPs are not legal requirements, but in practice compliance may be necessary to achieve a license for a nuclear activity.
- Many key SAPs are unique to UK (e.g. probabilistic numerical targets for risks to public and workers, ALARP requirement etc) – sometimes no equivalent requirement in IAEA standards and guides.
- SAPs can be prescriptive but achieving compliance may be rather unpredictable.
- Unpredictability of outcomes can lead to uncertainty and delay in planning of nuclear projects.
ALARP principle adopted in 1970s for risk to public (off-site) and workers (on-site) from operation of Nuclear Power Plants. Requirement came from 1974 Health and Safety at Work Act.

HSE 1988 report “Tolerability of Risk from Nuclear Power Stations” (TOR) states that:

- a risk of death due to radiation from a power plant of 1 in $10^6/yr$ would be acceptable for most people (1% of risk from background radiation or 1% of risk from fatal road accident)
- a risk of death above of 1 in $10^4/yr$ due to radiation from a power plant would be unacceptable
- in intermediate region, risk could be acceptable if it is ALARP – i.e. cost in time and effort of reducing the risk was disproportionate

Principle of ALARP (As Low as Reasonably Practicable) (2/3)
Principle of ALARP (As Low as Reasonably Practicable) (3/3)

- Demonstration that risks are ALARP is considered a legal duty for nuclear operators in UK.
- To show ALARP, must show that cost and difficulty of further safety improvements is grossly disproportionate to the reduction in risk achieved.
- Cost benefit analysis often used to support ALARP claims.

License Applicant Organisation

Owner/Operating Company
- Project dependent
- NSSSS Vendor
- Design and manufacture of main primary and secondary components including reactor core
- Safety analysis of postulated incidents and accidents affecting NSSS

Construction & Operating License Application
- Architect Engineer
- Design/Construction Organisation #1
- Design/Construction Organisation #2
- Design/Construction Organisation #3
- Level 1 design of plant excluding NSSS components
- Technical specification for equipment suppliers
- Layout
- Oversight of procurement and contract management
Typical Licensing Steps in Nuclear Build Programme

- Decision in Principle
  - Preconstruction (Preliminary) Safety Report approved by SA
  - Safety principles and constructability established
  - Environment Impact Statement approved

- Site preparation

- Construction Licence

- Construction

- Operating Licence /Fuel Load License

- Final Safety Report containing technical and operational aspects of the as-built plant approved by SA

- UK – Local Planning Permission/IPC
  - National policy framework established
  - Utility decision to proceed

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International Framework

- National safety bodies are autonomous but national regulations for design, construction and operation of Nuclear Plants generally comply with standard international practices.

- International bodies have published rules and guidelines for the safety of NPPs which are widely referenced e.g.
  - International Atomic Energy Agency (UN). Standards and guides for reactor design, construction and operation.
  - European Utilities Group – Guidelines for design of next generation of LWRs in Europe.
  - Western European Regulators Group – Regulatory framework for design and operation of reactors in Europe.

- National safety bodies often benchmark their regulations against these standards. However, most countries impose additional specific rules which go beyond international norms.

- Nuclear safety regulation has not yet achieved international standardisation as achieved in other safety critical industries (e.g. global aircraft industry).