Licensing of New Build Reactors in the UK – Part 1

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Imperial College – Nuclear Thermalhydraulics Course: February 2014

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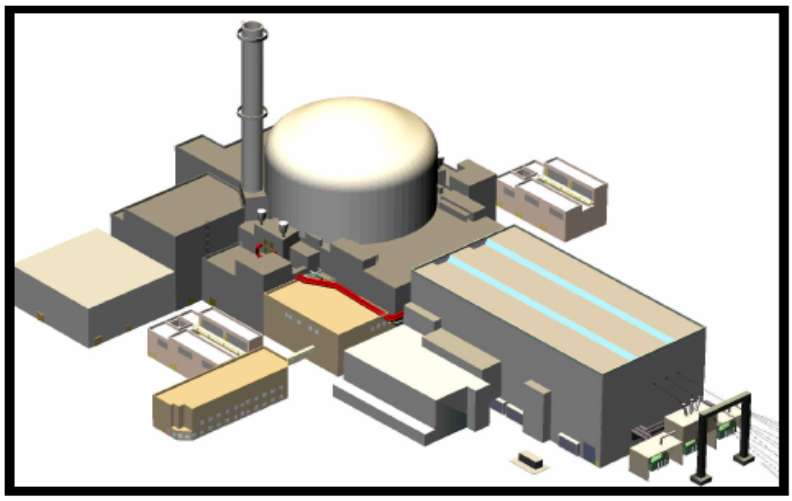
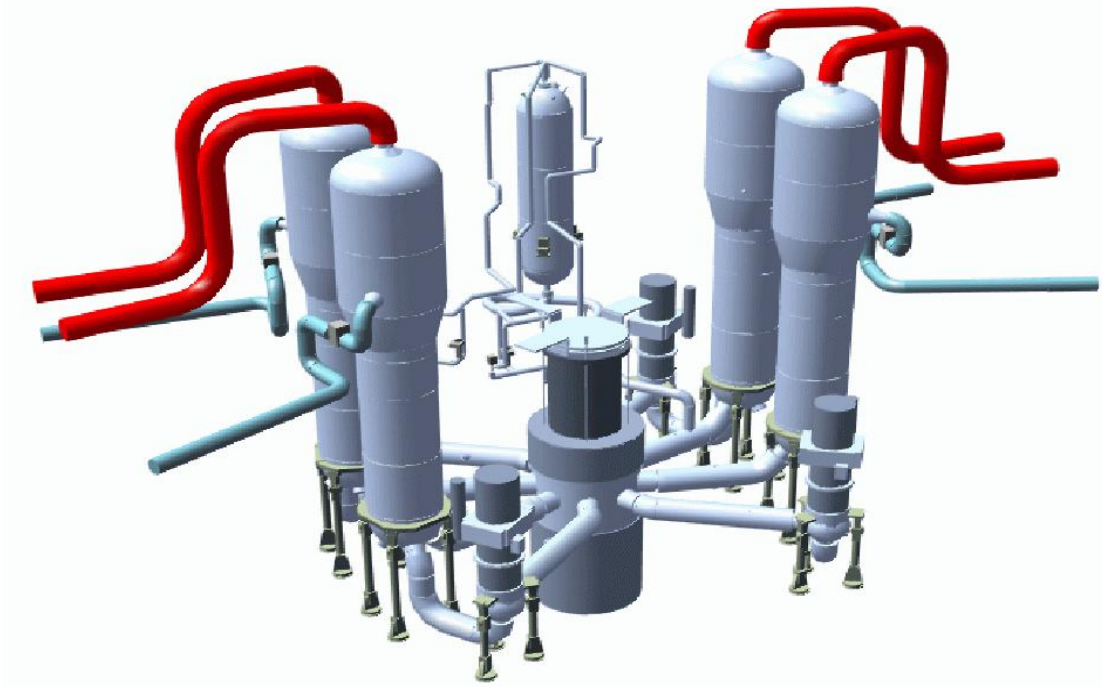
New Build Reactors in the UK – the EPR



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

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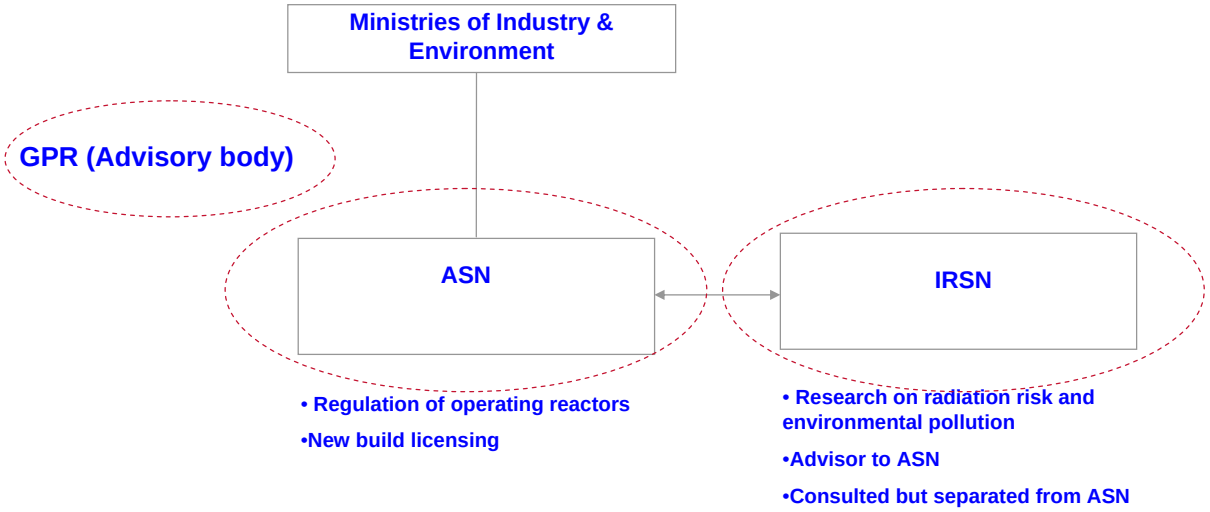
- **Role of Safety Authorities & Technical Support Organisations**
- Licensing Practices in different countries
- Application of International Rules and Frameworks
- Structure of a Safety Report & Standard Rules and Practices

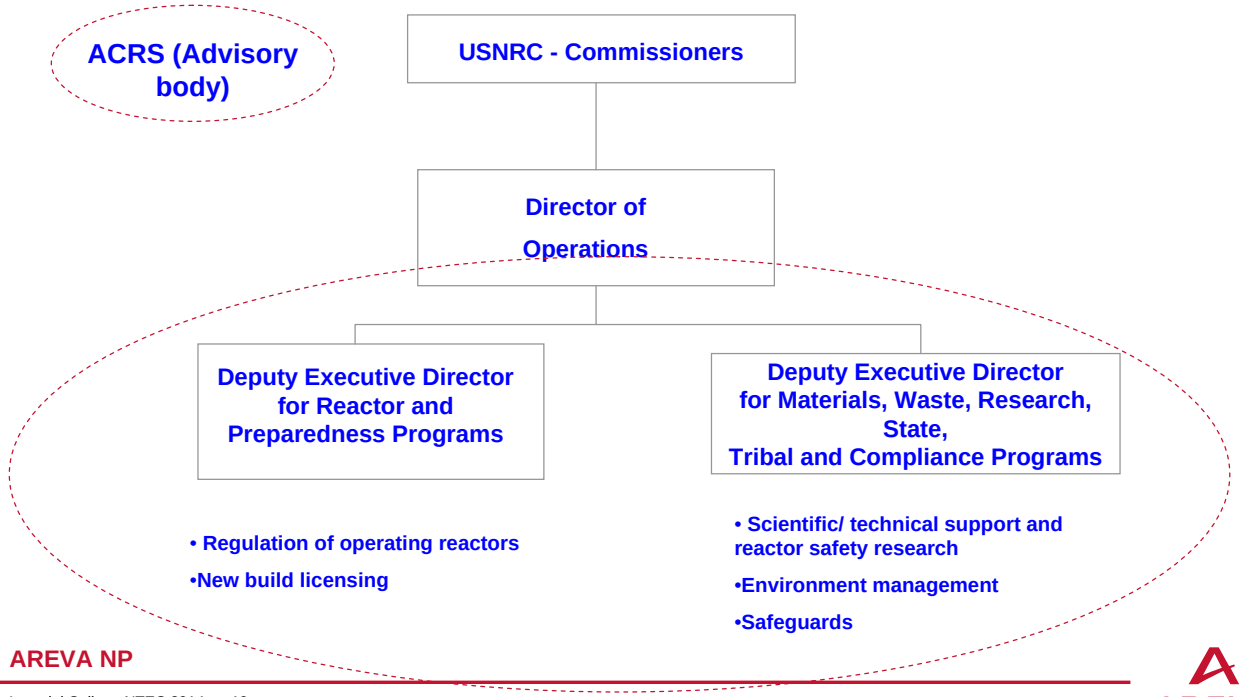
Nuclear Energy: Role of Safety Authority

- **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.

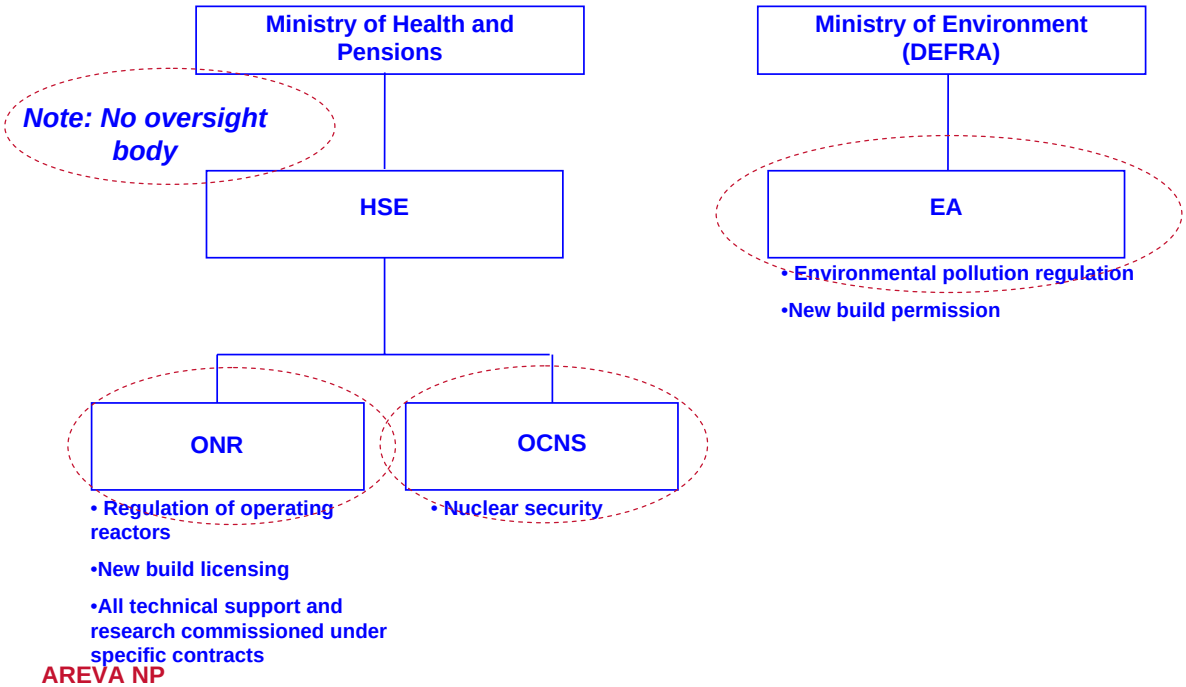
Safety Authority – French Model



Safety Authority – US Model



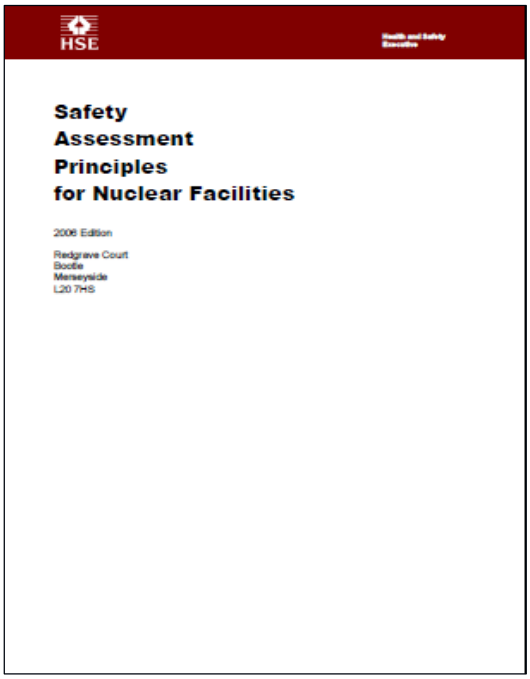
Safety Authority- UK Model



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)


HSE

Safety
Assessment
Principles
for Nuclear Facilities

2006 Edition

Redgrave Court
Bootle
Merseyside
L20 7HS

Contents of HSE/ONR SAPs (1/2)

Contents of HSE/ONR SAPs (2/2)

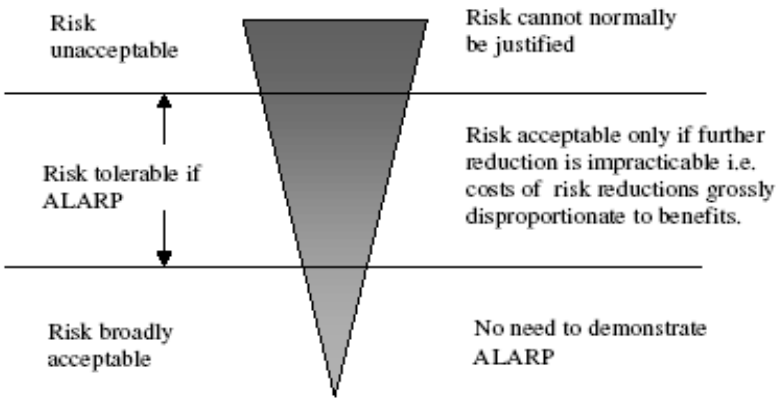
SAPs Discussion

- **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 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 <u>prescriptive</u> but achieving compliance may be rather <u>unpredictable</u>**
- **Unpredictability of outcomes can lead to uncertainty and delay in planning of nuclear projects**

Principle of ALARP (As Low as Reasonably Practicable) (1/3)

- 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

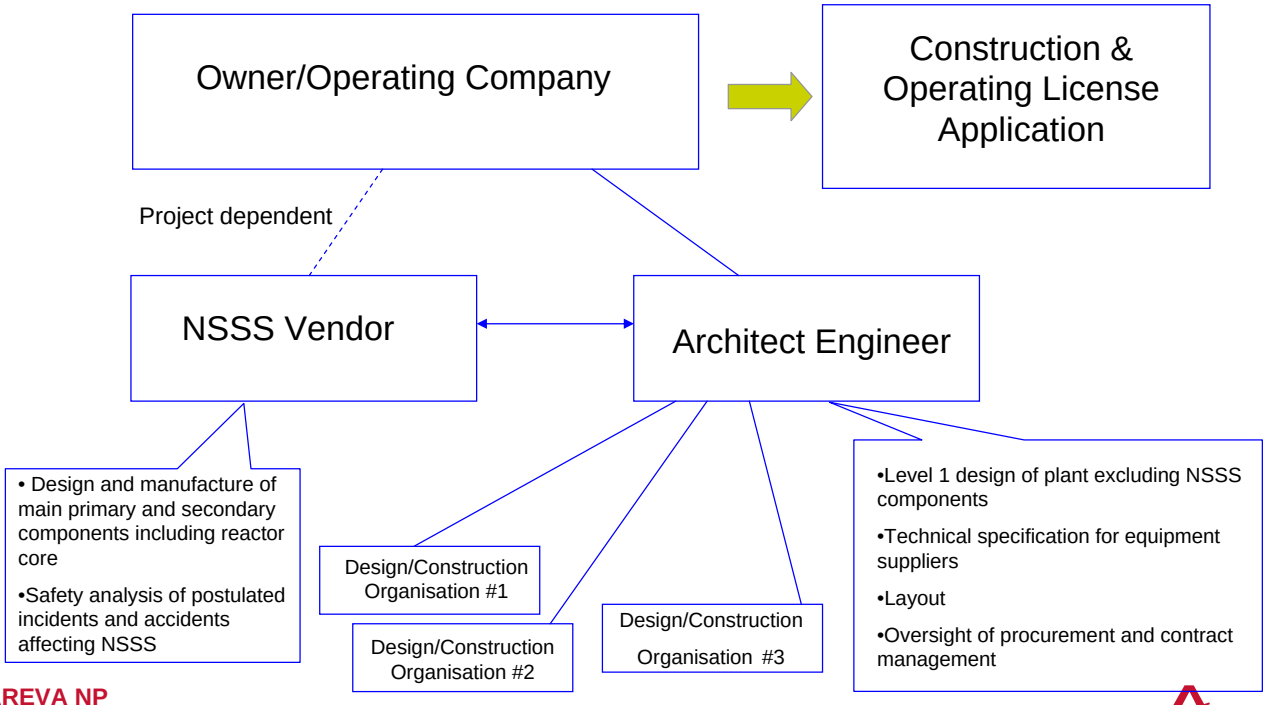
Principle of ALARP (As Low as Reasonably Practicable) (2/3)



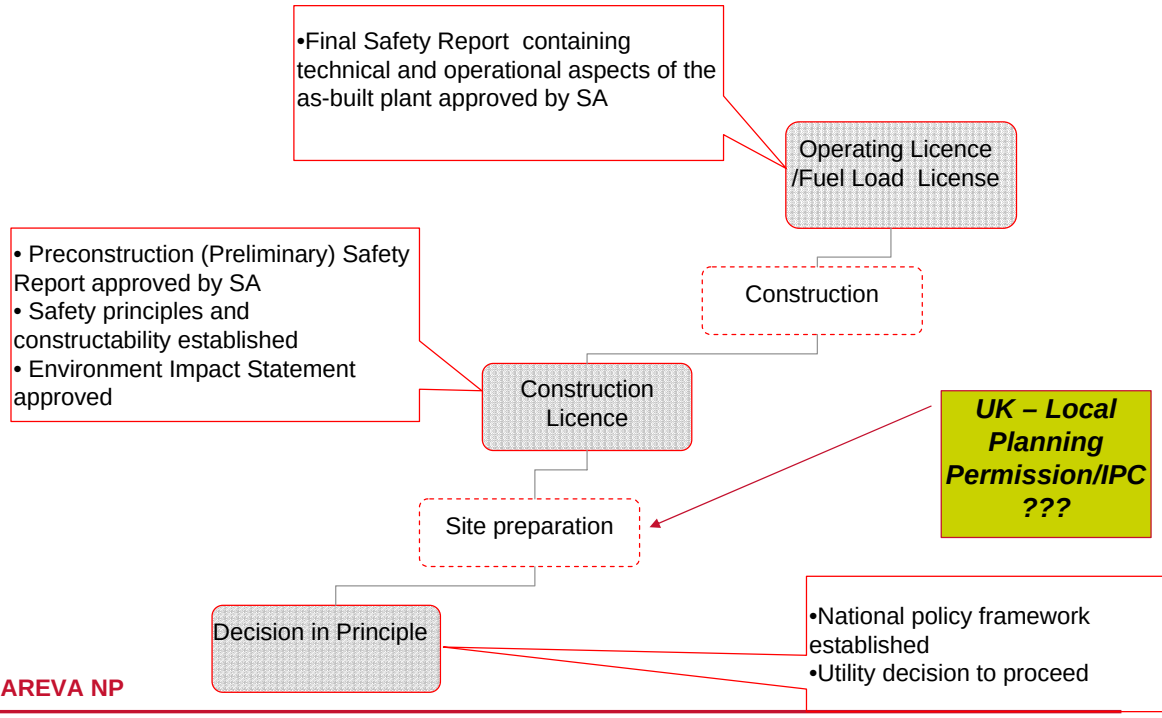
Principle of ALARP (As Low as Reasonably Practicable) (3/3)

- **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



Typical Licensing Steps in Nuclear Build Programme



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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)***