

Health and Safety Executive
Nuclear Safety Advisory Committee

HSE's Nuclear Contribution to the Energy Review

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Summary

This paper provides a summary of nuclear section of the expert report that HSE provided in response to DTI's request to inform the Government's Energy Review. The report conclusions include:

- the UK regulatory framework is appropriate for licensing new nuclear power stations;
- an improved process for pre-licensing assessments of new reactor designs should be adopted

To help reach these conclusions, NSD reviewed previous experience, held a stakeholder workshop, and invited public comments via our website. NSD also took advice from the recent Independent Regulatory Review undertaken by an IAEA team and their findings are also discussed in this paper.

HSE's submission to the Energy Review, the IAEA report and NSD's response are available on the HSE website and are attached to this paper

Introduction

To inform the Government's Energy Review, the Energy Minister, Malcolm Wicks, asked HSE for advice on the health and safety risks associated with some specific energy developments, including consideration of a new generation of nuclear power stations. In addition, the Government asked HSE for advice on the potential role of pre-licensing assessments of candidate designs in the event of new nuclear build.

HSE responded to this request with an expert report. The nuclear contribution was in two parts. The first part, in the main text, discusses the UK regulation of nuclear power and whether this is adequate for new nuclear stations. The second attached as an annex to the main report, discusses how NSD have historically gone about pre-licensing assessments of new reactor designs, examines current relevant issues, and proposes an improved process. The main elements of these are described below.

Two other current projects have had an impact on this work. These are the review of the Safety Assessment Principles (SAP's) and the Independent Regulatory Review undertaken by an IAEA led team. This paper provides

information on the IAEA review, but as a separate paper has been presented to NuSAC on the SAPs this is not discussed further here.

The Generation of Electricity by New Nuclear Power Stations

This part of the HSE report discusses the risks posed by the operation of a new generation of nuclear power stations and HSE's approach to ensuring that the industry manages them sensibly. It reviews the evolution of the UK nuclear power programme and international developments in reactor design. It concludes that any new build in the near term would use reactors of the so-called Generation III designs

Several designs of Generation III reactors are already operating or under construction and others are under development. In Japan, Advanced BWRs designed by GE-Toshiba, have been operating since 1996. At Olkiluoto in Finland, a European Pressurised Water Reactor (EPR) designed by Framatome ANP is currently under construction. A similar design is scheduled to begin construction at Flamanville in France in 2007. In the United States, a number of utilities have expressed interest in Generation III plants, including the Westinghouse AP1000 PWR, which has been given a formal (but limited) Design Certification by the US Nuclear Regulatory Commission. Other advanced designs of reactors are under consideration, or construction in Canada, the United States, Japan, Taiwan, India, and Korea. There are currently no advanced designs that have evolved from the UK's gas-cooled AGR type of reactors, but there are designs based on gas cooling and graphite moderation, such as the Pebble Bed Modular Reactor being developed in South Africa.

Third generation nuclear power stations are generally evolutionary in that they are developments of current designs taking advantage of modern safety philosophy, construction techniques, and benefiting from the significant operational experience gained on the proven Generation II designs. Third generation nuclear power stations will generally have some or all of the following features:

- a standardised design for each type to expedite licensing, reduce capital cost and reduce construction time,
- a simpler and more rugged design, making them easier to operate and less vulnerable to internal (fire, flood) and external (earthquake, aircraft impact) hazards,
- higher availability and longer design operating life - typically 60 years,
- greater use of passive safety systems, inherently safe design features, or more diverse, segregated and redundant plant,
- reduced risk of core melt accidents and improved accident mitigation,
- minimal effect on the environment,
- higher fuel burn-up to reduce amount of fuel used and the amount of waste.

From the safety viewpoint, vendors claim a reduction in risk compared with the older designs.

The report goes on to discuss the well established UK regulatory framework of the Health and Safety at Work Act, the Nuclear Installations Act, Nuclear Site Licensing and the processes applied by NSD for inspection of nuclear sites and assessment of safety cases. This framework has been vindicated in public inquiries and very recently has been subject to peer review by international experts, (the IAEA led review) and since it has been in place there has been a good safety record in the industry.

These same proven processes would be applied to any new reactors. Construction will not be allowed to commence until a nuclear site licence has been granted. NSD will not issue a Licence unless it is content with the proposed reactor design, the site location, and the licensee's organisation.

To be satisfied with the design, NSD will require to examine a detailed safety submission and be satisfied that the risks are ALARP.

NSD has satisfactorily regulated nuclear reactors of "first" and "second" generation designs. We anticipate that any new reactors proposed will be of the current "third" generation and they will therefore be an evolutionary design making use of proven technology, relevant operating experience, and benefit from modern safety analysis techniques and philosophies. We would therefore expect that licence applicants could demonstrate appropriate levels of safety and with risks no greater than those of existing reactors.

The Potential Role of Pre-Licensing Assessments of Candidate designs

The Energy Minister asked for an assessment of how HSE might go about the appraisal of reactor designs in advance of specific proposals for new build.

To respond to this request, NSD has undertaken a review of its regulatory strategy for licensing new nuclear power stations. In doing so, we have been mindful of the objective set by the Health and Safety Commission when it responded to an earlier Government review of the prospects for nuclear power (the Nuclear Review) in 1994. This was "to ensure, through the regulatory processes and the framework of legislation, that all licensees – existing and new – continue to maintain, or where reasonably practicable enhance, the existing high standards of health and safety achieved by the UK nuclear industry".

The report for the 2006 Energy Review summarises:

- previous experience of pre-licensing;
- previous (1994) regulatory reviews related to potential new build;
- significant changes since 1994;
- HSE's initial review of the issues to be considered;
- our stakeholder engagement exercise;
- feedback from the IAEA international regulatory review team assessment of HM Nuclear Installations Inspectorate and its work;

- implications of HSE's review of its Safety Assessment Principles for new nuclear power station design standards; and
- the process proposed for future pre-licensing assessments.

We have noted that some previous experience was poor, our pre-licensing processes were perceived as unclear, long-winded and inefficient. We have therefore endeavoured to look critically at our processes, taking account of the views of others, to explore the potential for improving our effectiveness.

To help us develop our thinking and to promote greater transparency, we embarked on a focused stakeholder engagement exercise. We summarised what we believed to be the key issues in a letter and invited a large number of stakeholders to a workshop to discuss them on 3 March 2006. At the workshop, the issues were openly discussed.

We used the feedback from the debates to confirm that we had identified the issues of most interest or concern to stakeholders. We then consolidated these into a list of 29 questions which we posted on the HSE website and we invited public comment on these during April 2006. A significant number of responses were received including comments from the public, licensees, reactor vendors, and Non Government Organisations. As anticipated from such diverse groups, the range of comments was large with differing views expressed.

We endeavoured to take account of the general tenor of these comments as we formulated our thoughts on future pre-licensing assessments.

In developing the proposed process for pre-licensing, we have held several objectives in mind:

- build upon the proven UK nuclear regulatory process, to protect people and society, ensuring risks are adequately managed;
- ensure a rigorous, robust and transparent examination of new build proposals;
- recognise the need for more opportunities for the public and other stakeholders to comment on safety issues on an informed basis than has been the case in the past;
- ensure our process is clear and transparent both to the public and to the industry;
- minimise uncertainties;
- make the steps in the process clearer;
- allow for advice from overseas regulators to be taken into account to the extent that is appropriate;
- suggest a timeframe that is adequate for our assessment and that supports these objectives, given appropriate resourcing, adequate submissions etc.

We concluded that a multi-stage assessment and licensing process should be adopted. This would have two phases: Design Acceptance; and Nuclear Site Licensing.

We propose that phase one is a 4-step Design Acceptance process that is appropriately site and operator neutral. Phase Two is HSE's assessment to support granting of a nuclear site licence and is thus site and operator specific. These are expressed in tabular form below with approximate timescales.

It should be noted that the precise timing will depend on a number of factors, such as: availability of suitable resource in NSD and outside; the quality of the safety submissions received; the significance of any issues arising; the responsiveness of those putting forward the designs for assessment; the ability to make best use of bilateral contacts with overseas nuclear regulators and their experience with similar reactor designs; etc.

PHASE 1		
Step	Process	Approx Timescale
1	Design and Safety Case Submission based on Generic Site Envelope	Applicant is responsible
2	Fundamental Safety Overview	3 - 6 months
3	Overall Design Safety Review	6 - 12 months
4	Detailed Assessment for Design Acceptance.	2 years
PHASE 2		
Site Licence Assessment		6 – 12 months

Phase One - Design Acceptance

We propose that phase one is a 4-step Design Acceptance process, with a duration of something in the order of 3 years, depending (inter alia) on the applicant's readiness and responsiveness, as follows:

Step 1 – Design and Safety Case Submission based on Generic Site Envelope

The applicant (a potential licensee, or a reactor vendor, or other consortium / partnership) submits a design and safety case to HSE.

Assuming the applicant did not identify a specific site for the proposed plant, it would need to specify generic siting characteristics against which we would assess the effectiveness of the safety provisions incorporated into the design.

Step 2 - Fundamental Safety Overview

This would be a short HSE review (say, 3 - 6 months) of the fundamental acceptability of the proposed reactor design within the UK regulatory regime. The idea would be to identify any major design aspects or safety shortfalls that would prevent the design being the basis for granting a nuclear site licence in the UK.

The output from this would be a public HSE statement on the basic acceptability or not of the proposed design.

Step 3 – Overall Design Safety Review

This is a more in-depth review by HSE (say, 6 - 12 months) of the safety aspects of the proposed design. We would judge the safety case in more detail against key aspects of our Safety Assessment Principles such as passive safety, plant integrity, segregation and redundancy provisions, and protection against hazards. One of the aims would be to identify if any significant design or safety case changes were likely to be needed in order to comply with UK requirements.

The output would be a public HSE statement identifying overall potential acceptability and listing safety issues requiring resolution during Step 4.

Step 4 - Detailed Assessment for Design Acceptance

This is a full in-depth HSE safety assessment. This would examine all aspects of the submission including more detailed ALARP assessments and may include inspections of the Applicant's procedures and records and independent verification analyses by HSE. Additionally, it may include details of the procurement and quality management arrangements to secure compliance with the design intent.

The output would be a public HSE statement providing a Design Acceptance certificate (if successful). The successfully Accepted Design will then be suitable for construction, once a licence was granted, on any UK site demonstrated to be within the generic siting envelope.

Phase Two - Nuclear Site Licensing

Phase Two of the process is HSE's assessment to support granting of a Nuclear Site Licence. This requires assessment of the plant, the specific site and the operating organisation (who will become the licensee).

The design assessment should be a simple process referencing the Accepted Design and addressing any features specific in the particular application.

The site application should be verification that the agreed generic site envelope, covers the specific site and a suitable emergency plan is proposed, and that it conforms with Government siting policy.

The main element of the Phase Two Site Licensing process will be an examination of the prospective licensee's organisation for safe operation of the site.

If the Applicant provides a detailed and adequate submission we would anticipate HSE's Phase two assessment would take around 6 – 12 months.

Public Involvement

At the same time as submitting safety cases to HSE, we would expect applicants to place as much information, including the safety case, into the public domain about their proposals as commercial-in-confidence and security considerations would allow, so that any interested parties might make representations to HSE on any health and safety issues that are relevant to the case that concern them. HSE would take these representations into account in coming to decisions and would publish a report explaining how it had done so when it published its conclusions on Design Acceptance.

Resourcing and other factors

There are many factors that might influence the pre-licensing process, or affect the timescales. These are discussed in our report, but chief among them is the availability of suitable resource for our work. We do not have surplus resource with which we could currently undertake the proposed multi-stage assessment and licensing process. Indeed, at present we are seeking to recruit to meet our current work programme and that foreseen for other sectors of the nuclear industry. Any pre-licensing programme would need to build in a lead time within which additional staff would be recruited and suitably developed.

Ultimately, insufficient NSD resource of the right quality will extend the timescales in which we can conduct our assessments.

Our stepwise strategy to the assessment of the design should assist, however, in addressing the resourcing risks. It allows for a graduated build up in resourcing as more in-depth assessment is required.

Feedback from the international regulatory review team assessment of NSD

To test the capability of our nuclear regulatory regime to respond to any new nuclear build proposals, the Chief Inspector proposed to Government that it invite an IAEA team of nuclear safety regulators to conduct a peer review of

our organisation and regulatory activities. This peer review was carried out at the end of March 2006. The team was led by the IAEA as part of its International Regulatory Review Service (IRRS) and was made-up from IAEA staff and senior members of overseas nuclear regulatory bodies, including the Heads of some of these bodies.

The specific purpose of the IRRS mission to HSE was to evaluate the regulatory effectiveness of both the HSE/NSD regulation of existing nuclear power plants and its readiness to regulate and licence any new reactor designs. This was in the context of there not having been any new build of a reactor in the UK since the 1980s.

The IRRS team identified 13 good practices within NSD and these will be publicised world wide for the benefit of other countries. These good practices included:

- the mature and transparent regulatory system and the advanced review process;
- highly trained, expert and experienced staff;
- a flexible regulatory regime that sets clear expectations for the licensees and permits NSD to make decisions on well justified technical grounds.

The IRRS also identified 14 suggestions and 13 recommendations for improvement. These included:

- establish an appropriate budget and staffing levels to accomplish all assigned work;
- improve the independent capability for safety analysis in specific areas;
- improve operating experience feedback assessments and follow-up the corrective actions;

NSD reviewed the recommendations and suggestions and concluded that:

- seven of the findings need to be addressed as part of HSE's work associated with the review of energy policy;
- four of these and a further two findings need to be addressed urgently if HSE is requested to undertake further work associated with new build of nuclear power stations; and
- the remaining eighteen findings will be addressed as part of NSD's continuous improvement programme.

Specifically on the topic of potential new build, the IRRS team recommended that NSD should develop and document the authorisation process for new build including step-wise licensing and guidance for the potential applicant. The team also stated that, in case of receiving a new application for a nuclear power plant, NSD has to acquire significant additional resources in order to meet its current responsibilities and to meet this new challenge. In addition, the IRRS team provided some expert opinion regarding the planning and execution of new build activities.

The IAEA report gives a balanced picture. NSD believe that the results of the IRRS mission have given independent confirmation of the strengths of the UK nuclear regulatory regime. NSD aim to take the recommendations and suggestions for improvement forward positively. We welcome the IRRS expert advice on the new build aspects and we have taken this into account in preparing our expert report, particularly in identifying the processes we suggest are applied to pre-licensing of candidate designs.

Conclusions

NSD has provided input to HSE's expert report responding to DTI's request to inform their Energy Review. The report's conclusions include:

- the UK regulatory framework is appropriate for licensing new nuclear power stations;
- and
- an enhanced process for pre-licensing assessments of new reactor designs should be adopted, based on a two phase approach of generic Design Acceptance followed by specific Nuclear Site Licensing.

To help reach these conclusions, NSD reviewed many current relevant issues, considered previous experience, and invited comments via a stakeholder workshop and our website.

NSD also took advice from the recent Independent Regulatory Review undertaken by an IAEA team. The IAEA report gives a balanced picture of some of the strengths and areas for improvement. NSD aim to take the recommendations and suggestions for improvement forward positively.

HSE has also reviewed its SAPs against IAEA Safety Standards and is in the process of finalising the revision of them taking account of the views of interested stakeholders.

HSE's expert submission to the Energy Review, the IAEA report and NSD's response are available on the HSE website.

Should the government's energy review require consideration of new nuclear power stations there will be several issues for NSD to address, such as developing procedures and guidance on the proposed multi-stage Design Acceptance process and seeking increased resources to undertake the additional work involved through pre-licensing to station construction and commissioning.

Recommendations

NuSAC to note the conclusions.