

The Health and Safety Executive
A Study of the Impact of Peer Reviews
on Nuclear Safety Cases

by

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1 Introduction

The Peer Review of Safety Case documents is undertaken throughout the nuclear industry but the results from those reviews accompanying the safety document can range from a full review report to just a Certificate of Endorsement.

Against this variable climate, this study to assess the impact of Peer Review on nuclear safety has been commissioned by the Health and Safety Executive and carried out on their behalf by NNC Limited.

The aim and purpose of the study is given in section 2. A literature survey has been reported and summarised in section 3. The organisations included in the review, an assessment of the current practices and the types of review are given in section 4, 5 and 6. The detail of the discussions held are given in section 7 with a summary of the findings and recommendations given in section 8 and 9 respectively. The conclusions are given in section 10.

2 Aims and purpose of study

Certain events have taken place recently which may raise some doubt on the ability of an independent review of a design to identify deficiencies in the original design.

An example with fatal consequences was the collapse of the walkway at Port Ramsgate in September 1994 Ref 1. In this case the original designer had overlooked some of the significant loadings and the likely failure modes. It was also shown that the independent design check calculations, which despite some increase in the predicted stresses, endorsed the design as acceptable.

The independent review apparently only repeated the original assessment and its scope did not challenge the basic loadings, the manufacturing details or the long term service duty and maintenance issues. Any one of which would have prompted the design to be changed and the final catastrophic failure avoided.

Existing legislation is adequate to define the roles and responsibilities of all the parties involved in their duties to ensure that the walkway was safe for operators and users. This means that the purpose of the independent review and the reviewers legal obligation are known and are important parts of that process of ensuring safety. The intent is that any deficiencies or oversights in the original design are removed by an Independent Peer Review, an IPR.

In the case of a UK civil nuclear installation, the Site Licensee under LC14 is required to manage the production and assessments of Safety Cases where the documentation justifies the safety during the various phases of the site. As part of that process the Nuclear Installations Inspectorate, the NII, requires that the licensee manages a Peer Review of the Safety Case.

For the MoD facilities which deal with any support to the nuclear submarines or shore test reactors it is necessary to produce a Site Safety Justification which consists of a series of nuclear safety reports. To obtain authorisation to operate the site it is

necessary to adopt the Authorisation Conditions set out in Annex A(i) to BR 3018 Ref 2. These are similar to the licence conditions given in Ref 1 but the condition 14 dealing with the safety documentation specifically states in arrangement b(iii) that the document must be reviewed by independent suitably qualified and experienced people. An IPR of the Safety Case is therefore specifically called for in the site licence authorisation conditions.

The need for a Safety Case document to be independently reviewed has been identified in the site licence conditions but experience can be cited which shows that an IPR can be completed, and the Ramsgate walkway is an example, which does not bring any benefit through greater assurance of safety.

The aim of this study is to establish the effectiveness of an IPR on improving safety portrayed in a Nuclear Safety Case.

To achieve this aim the objectives of the study will be as follows:

- (a) review the literature and provide an overview on how the Peer Review process can impact on safety in high hazard industries
- (b) to examine the Peer Review as managed in the UK nuclear industries
- (c) identify any important factors which influence the benefit of the Peer Review to nuclear safety
- (d) produce a report giving details of the findings and any recommendations.

3 Results from the Literature Study

A literature survey was completed on both international and national documents covering the Peer Review process relating to the nuclear industry and the outcome summarised in Ref 3. A majority of the documents originated either in the USA or from the IAEA.

It was found that the information on Peer Review guidance was confined to the activities of specialist teams such as Probabilistic Safety Analysis (PSA) or within an organisation.

The information on design verification showed many similarities with Peer Review requirements. A specific document dealing with good practice in the US Construction Industry which is also used in the nuclear industry, Ref 4, was found to be one of the most broadly based documents drawing parallels between the different industries and review/verification processes.

This document like many others concentrated on the management of the review dealing with the scope, the documentation, the independence and competence of the reviewer and the close out of reviewer comments.

The document also stated that the reviewer should highlight the strengths as well as the weaknesses. This is an important aspect of the Peer Review which can contribute to portraying the robustness of a Safety Case. In the course of NNC defining the IPR to be undertaken on the Safety Case for the Faslane Shiplift a similar requirement was identified. Here it was described as ‘a positive and negative IPR report’.

Although the requirements for design verification were considered useful guidance for Peer Reviews in the absence of any relevant international or national nuclear standard, there does not appear any clear definition on what should be reviewed, or the depth and how to manage the reviewers comments.

The literature survey also showed that the quality of the Peer Review was directly related to the quality, competence and experience of the reviewer.

There was no information found on any specific Peer Reviews to indicate how the quality of a review had changed with a change in the reviewers competence. However it would appear to be a pre-requisite that a review will only be of benefit to a Nuclear Safety Case if the reviewer has the relevant competence.

In general there was a lack of evidence on lessons learned except for a report of a PSA Peer Review. This highlighted the need for good documentation, the danger of taking on an advisory role if involved in the original design and the tendency to concentrate on negative comments.

Findings

Finding 1

No International or National Nuclear Standard for Peer Reviews was found.

Finding 2

Very little evidence on Peer Review feedback was found and no documents were found which indicated how a Peer Review of Safety Case documents had benefited the nuclear safety.

4 Review of current Peer Review practices

The methods considered for the assessment of the effectiveness of the Peer Review on nuclear safety were either:

- (i) to establish the details of the processes currently adopted and to investigate any benefits or shortcomings which could be identified to have an influence on the quality of the review.

or

- (ii) from a sample of completed Peer Reviews analyse the content of the comments and their required resolutions to enable the impact of the Peer Review on the outturn of the Safety Case to be assessed.

In order to assess the Peer Review issues which benefit the general situation it was judged that the first method was more appropriate. A review of a typical Peer Review showed that the comments were very specific and pertinent to the document being reviewed. The comments however can be broken down into groups. For example a comment requiring additional information does not read across to other documents but it does give a general guide to the scope which should cover the clarity of the argument. A comment on the factors of safety will read across to the general scope that the assumptions or the assessment methods need to be shown to be appropriate and their bearing on the nuclear safety explained. Thus the scope of the Peer Review plays an important factor. However its interpretation in assessing a document will be closely related to the competence of the reviewer. Hence all the specific comments will also reflect not only the document but also the specific reviewer.

It was therefore decided for the generic application that assessing the current management of the Peer Review process will provide a good insight into how quality of the review affects nuclear safety.

Thus an indepth discussion with the Peer Review managers of the selected organisations would be conducted using a framework of questions. The details of the questions are given in Appendix A which cover the following topics:

- Peer Review policy and the use of standards
- organisation of the Peer Review
- scope of the review
- process and management of the selected reviewers
- reporting of the reviewers comments and the close out of corrective action
- feedback on experiences with Peer Reviews.

5 Range of organisations included in the study

As part of the study it was important to establish the current Peer Review practices carried out by the major nuclear licence holders. It was also one of the objectives to include the review practices in hazardous industries other than nuclear.

For the nuclear industry it was planned that organisations representing the full range of the different facilities would be covered. These include the following:

- civil nuclear generation
- production process nuclear plant

- nuclear waste processing plant
- MoD nuclear submarine facilities
- MoD nuclear process plant.

For reasons of security it was planned not to include the MoD nuclear power generation for the submarines.

To capture the Peer Review practices in hazardous industries other than the nuclear industry, it was planned to include a representative company from the oil industry who has completed Safety Cases for offshore oil rigs and a representation from the chemical industry where safety reports form part of the COMAH Regulations, Ref 5.

Approaches by NNC and HSE revealed that the oil and chemical industries did not consider the comparison between their Peer Review processes and those required for a nuclear site licence was beneficial and therefore declined to take part in the study. Consequently this study is restricted to the nuclear industry, although DML at Devonport which is a rapidly developing nuclear site declined to have any involvement in the study.

The following organisations were included and a review of their practices was completed.

- (a) British Energy Generation Limited
All AGRs and Sizewell B PWR Power Stations.
- (b) BNFL – Magnox Generation
All Magnox Power Stations.
- (c) UKAEA
Harwell, Dounreay, Sellafield, Winfrith
No reactors with fuel, many plants are in their decommissioning phase.
- (d) BNFL – Sellafield
Nuclear process plant at Sellafield.
- (e) BNFL – Springfield
Fuel production and enrichment includes chemical as well as nuclear hazards.

- (f) BAE Systems Marine

Barrow Site Licence for nuclear submarine construction and pre/post sea trial commissioning and testing.

- (g) AWE – Aldermaston

Nuclear process plant at Aldermaston.

6 Type of review

It is quite clear that a review which has the same scope and objective is called different names.

It is also quite clear that the same name is used by different organisations for reviews which are different in their scopes, depths and objectives.

The result of this lack of uniformity in the definitions of reviews potentially leads to doubt and confusion between the licensee and the nuclear regulator when presenting the Safety Case. It is essential that the individual inspector and the Safety Case manager have the same interpretation on the extent of a review from its title.

During the preparation and approval of a Safety Case there are several stages at which any document is reviewed and assessed. Some of these will be carried out by suitably qualified reviewers who may be independent of, or belong to, the originators organisation.

Irrespective of the status of the reviewer it is essential that the industry adopts some agreed titles which define the type of review.

The three different reviews which have been identified are:

- (a) The review which is part of the originators company procedures which form the base of the Quality Assurance. For example a typical review ensures that the data used are the correct project data, conducts verification and validation checks on calculations and mathematical model, checks the event trees and fault schedules, and checks that the correct data has been used in the assessment stage. In the case of a safety report this check would ensure that the appropriate safety requirements had been defined, the relevant hazards had been addressed and the relevant support data had been used.

The review is usually very focused on the technical aspects and is frequently termed a document verification or an independent technical assessment. The details of the required checks will be embodied in Work Instructions. This will record the outcome or the verifiers comment and following their resolution the document will be approved.

- (b) This type of review is carried out on an approved project document. The object of the review is to challenge the assertions and content in the document

and its purpose. This means that a broader awareness is required of how the document fits into the hierarchy of documents which make up the Safety Case. Also a broader awareness of the nuclear facility is required including the function of its various systems, the hazards and fault schedule, the control and protection systems and the interaction between systems.

This allows the reviewer to judge the appropriateness of the contents of the document and any assumptions made and the adequacy of any information together with any assessments or conclusions reached.

Since the document has already been approved by the originator's organisation, then the safety document is now being reviewed as part of the process undertaken by the licensee in preparing the document for consideration by the Licensee's Nuclear Safety Committee. If satisfactory it will be endorsed and accepted as part of a Nuclear Safety Case which is required to demonstrate that an acceptable risk is predicted from the operation of a facility. At this stage the reviewer will be independent of the originator and this review is referred to as either an Independent Peer Review, IPR, or an Independent Nuclear Safety Assessment, INSA.

This study showed a near equal split between the use of the two different names of this type of review as shown in Table 1.

- (c) The third style of review whilst still referred to as an IPR or INSA differs from type (b) in the attitude adopted by the reviewer in the use of judgement. The use of reviewers with the appropriate experience should allow the soundness of the claims made in the safety documents to be judged even if the full in depth background information is not presented. However some INSAs are conducted solely on the basis of the information provided. Thus in the absence of the background information and the non-application of judgement on the part of the reviewer it is likely that a large volume of comments will be generated. On the basis of the sheer number of comments this would appear to be a thorough review but more likely the number of comments detracts from the important issues with safety implications. Whilst this should be controlled through the management of the review process, judgement is subjective and therefore just relying on the scope of the IPR is no guarantee that unnecessarily comments will not be generated. This point is discussed in section 7.4 of the document.

The extent of this study did not address the effectiveness of the verification review, type (a). This is the first level of review and is usually contained in the quality procedures employed by the organisation responsible for the generation of the safety documents. The management of this process with regard to the experience of the reviewers, the scope of the review, and its breadth and depth is an important first step to ensure a high quality document is presented for IPR to avoid using an IPR to remove the shortcomings in an inadequate document. A separate study to establish the general standard of this first level review, its management, the selection of reviewer, and the scope of the review would complement this study of the impact of the IPR process.

Findings

Finding 3. The different styles of reviews have the same name. The same type of review has different names. This leads to confusion between the Licensee and the nuclear regulator on exactly what depth of review has been completed or is planned to be undertaken.

Recommendation 1

An agreed title and definition of the independent review conducted by the Licensee before presenting the safety report to the regulator needs to be established and adopted by all UK nuclear site licensees.

Recommendation 2

A study of the first level review should be conducted to establish its contribution to the quality of safety documents specifically to understand the management of the process and whether this achieves a consistent high standard of document to be presented for Independent Peer Review.

7 Impact of Peer Review on nuclear safety

In this section the term Peer Review refers to the INSA/IPR described in review type (b) in section 6.

From the discussions with the seven nuclear organisations it became apparent that there are five main areas which have an influence on the effectiveness of a review on the quality of the Nuclear Safety Case.

These areas are:

- (i) organisation and management of the review
- (ii) the selection and independence of the reviewer or team of reviewers
- (iii) the defined scope of the review and how the close out of comments is managed
- (iv) the allocation of sufficient time for the review
- (v) the feedback of benefits gained from previous reviews.

7.1 Organisation and management of Peer Review

As stated in section 2 Licence Condition 14 requires a Peer Review of the safety documents as part of the Licensee's responsibility to produce a Safety Case. In all the organisations it has found that the person responsible for the Safety Case was clearly identified even though the ultimate Site Licence holder may be the Chief Executive of

the company. This line of responsibility is defined in the company's safety policy documents.

These safety policy documents all define which part of the organisation is responsible for managing the Peer Review process when requested by the Safety Case owner. As shown in Table 2 the Peer Review management is placed in a completely separate part of the organisation to that which has responsibility for the generation of the Safety Case documents. The Peer Review division reports upward on a separate line to the executive so that the Peer Review has equal importance organisationally as the safety document itself and the applied QA. This means that not only is the independence of the reviewer secure but that his views will be carried through due process for resolving issues without interference from commercial pressures. However to maintain the absence of commercial pressures, the review organisation carries a responsibility to conduct its activities in an efficient manner in accordance with the scope agreed for the IPR.

The advantage of this clear responsibility route is that all Peer Reviews in a given organisation will be governed by the same procedures and hence should be to the same quality.

The need for Peer Review of a document is dictated by the nuclear risk posed by the plant and/or its modifications for which a Safety Case is required. It has been found that for exactly the same risk the different organisations use different category identifiers. The range of categories is shown in Table 3 where the divide between mandatory and optional Peer Review is shown.

The additional categories in the mandatory class only subdivide the minimum approval route of the document. This will define when a document is to be forwarded to the regulator, such as the NII, for approval or whether it is for information on issues being approved by the organisation's Nuclear Safety Committee. This subdivision has no influence on the effectiveness of the Peer Review but it may influence its scope.

The use of an alpha numeric mixture of categories seen in Table 3 to distinguish between facilities and modifications and between nuclear reactors and process plant is not uniformly rigorous across the industry. This table only indicates the number of categories used by an organisation. The different categories do not indicate any relative importance or level of risk between organisations. However within a single organisation there is a benefit for the category to signal the difference in the potential risk from nuclear radiation as a consequence of failure in a reactor compared with a process plant. Also the difference between a new plant compared with a modification to a plant where a Safety Case already exists is worth indicating to a Peer Review to ensure that all pertinent documentation and safety requirements are reviewed.

The use by AWE of the higher number to signal the higher risk is directly opposite to the system used in the remainder of the industry. This could lead to confusion in the reviews carried out by the Regulator. However, the categorisation is a system used by the various organisation as an aid to managing their nuclear risk and to ensure that their safety documentation receives the correct level of peer review as well as a key to

distinguish the document approval route. The differences in the number of categories described in Table 3 do not indicate any difference in the level of risk between the different organisations. Whilst these remain essentially organisationally based it is not essential to the quality of the IPR that there is a universal categorisation but to avoid any confusion within the industry it may be desirable that such a system be adopted.

The definitions used to provide guidance on the appropriate category are not standard definitions but they do convey a graduation to the nuclear risk. The definitions in Ref 2 for example make a distinction between offsite, onsite and in building radiological doses between the different categories. In the case of modifications, these will apply when only one modification or decommissioning activity occurs at a given time. There does not appear to be any guidance on the need to review the collective category of simultaneous activities where individual modifications could collectively cause a more serious consequential risk. The situation where different interactive plants are involved is more likely the case where an increase in the risk has not been identified.

All the organisations have, or are in the process of producing a procedure for the management and implementation of Peer Reviews. These show a reasonable degree of consistency which reflects the regular discussions which have taken place within the industry on this topic. Therefore the control of the Peer Review through definitions of responsibilities, control of the methods used for reporting and closing out actions should achieve a consistent high quality to the Peer Review process.

Whilst there are differences in the detail given in the procedures, for example BNFL Magnox Generation have a much greater number of interim forms to complete in the Peer Review process than those required in the BEGL procedure. These have not been identified as having any direct influence on the contribution Peer Review has on safety. It appeared a distinct advantage to the quality of the process that each organisation positively owns its own procedure. Each was enthusiastic about their own procedure, ensuring that it is applied rigorously and confident that it is a benefit to the quality of the Peer Review.

Therefore it is recommended that the current procedures remain unchanged.

A detailed review of the Peer Review processes covering all types of nuclear facility and Safety Cases to establish whether there are key activities which should be recorded and contained in all procedures would be a benefit.

Findings

Finding 4. The organisation set up to manage Peer Reviews is clear and unambiguous with equal recognition by senior management with the Safety Case generation. This should produce consistent quality to the Peer Review process.

Finding 5. The category assigned to the safety document is helpful to the Peer Review process and the distinction between new plant and modifications helps to

define the extent of the review. However the scope of the Peer Review is consistent across the range of safety case documentation.

Finding 6. Using the numbers with different risk ranking could cause confusion in the NII.

Finding 7. No guidance has been found on the categorisation of multiple simultaneous modifications.

Recommendation 3

Explore the benefits of a uniform numbering system for categorisation purposes throughout the industry.

Recommendation 4

Guidance should be defined on categorisation principles to be followed when simultaneous modifications are taking place. This should also apply to decommissioning although if this is related to one project the coordination should capture any increase in risk.

Recommendation 5

Identify mandatory key activities in the Peer Review process which should be recorded in the Peer Review procedures.

7.2 Selection of reviewers

The first step to be completed by the manager who is requested to carry out a Peer Review will be to establish the extent of the document in terms of the facility and the disciplines covered. Based on this information he will appoint from his own organisation a Review Officer who will have a variety of titles as shown in Table 4 but who will have a broad understanding of significant nuclear safety issues related to the facility in question.

The Review Officer's role is to define the Peer Review project, the scope of the review and the skills and capabilities required. For a simple document this may just involve the review officer but more often a range of specialist assessors will be required to form a team to adequately cover all aspects. These supporting assessors are then selected and their appointment agreed with the manager.

In all organisations the review officer and supporting assessors will not have been involved with the preparation of the documents to be reviewed. This need for independence may require that external assistance is sought from outside the review department and this may be from outside the organisation.

Whilst recognising the need to select reviewers who are independent from the generation of the safety case and whose management is also independent from the safety case management, the balance between independence and appropriate experience is the one most important issue which affects the significance of the

impact of the Peer Review on safety. A knowledge of safety issues allows the boundaries of the Safety Case presented to the intelligently challenged in a manner which has relevance. It also allows that the correct balance will be struck between the top document and the number of detailed references which are incorporated into the review. The need to debate only the important issues in the discussion between the author and the assessor, avoiding bulk trivia is important.

The interpretation of the scope which achieve these ideals will depend on the experience of the reviewers selected and the direction given by the review officer where a team of reviewers exists.

A SQEP register of potential reviewers is only managed by BEGL. This may be as a result of a significant number of independent reviewers with suitable experience on older reactors existing in external consultancies. This register is formally reviewed to ensure that a person's experience still remains credible.

At BNFL, Springfield, they seek to secure reviewers who have been the author of a Safety Case on another similar plant. The Peer Review therefore captures the direct experience from the other plants which acts as a catalyst to broaden the base on which the Safety Case is reviewed.

All organisations have a list identifying the main reviewers in the review department who have the experience to take on the Review Officer role, and specialist support from external consultants. In the main the Review Officer and his manager will ensure that the individual is SQEP and that the independence is not prejudiced.

It is also recognised that the affect of programme and scheduling will mean that the review officer with the ideal experience may not be available. Therefore it is likely that reviews are conducted with less experienced reviewers which could potentially produce a less effective assessment of the Safety Case. No evidence was available or implied during this study that showed that choosing less experienced reviewers has compromised the benefit of the review on nuclear safety.

The register of SQEP identifies the individuals past experience which will include the following:

- extent of technical expertise
- familiarity with plant or facility
- experience in safety case writing
- experience in conducting Peer Reviews

However there was no evidence kept on the register on the ability of the individual to identify the broader issues during a review or to identify inconsistencies or incompleteness of the safety arguments. There was evidence through experience from previous reviews that Peer Review managers gained an understanding of the strengths of the individuals on the SQEP register and where possible selected reviewers on that basis. However this reviewing effectiveness was not formally recorded in the SQEP register.

Findings

Finding 8. The Peer Review department sets out to assign the most appropriately experienced reviewer as the Review Officer. The Review Officer is expected to gather additional reviewers to cover specialist areas and areas of nuclear safety requiring specialist knowledge and experience.

Finding 9. A SQEP register of reviewers is not held by anyone other than BEGL and the suitability of a person is mainly based on the judgement of the manager and the Review Officer.

Finding 10. No formal record has been found in the SQEP registers of the effectiveness of the reviews carried out by individual reviewers in identifying the broader issues or consistency in the safety argument.

Finding 11. There is generally no training given on how to review although BEGL were just introducing Peer Review training. However the training was on the review process and all organisations set down guidelines which show what areas to cover what questions to raise and what checks to make. Training on how to review, which is more on how is experience harnessed in a review, is a difficult aspect to resolve.

Recommendation 6

To establish whether the SQEP register addresses aspects which have not been considered during the management selection of a suitable Review Officer. The objective being to make the selection of a Peer Reviewer a more rigorously assessed and traceable decision which would be part of the evidence included with the Peer Review approval certificate.

Recommendation 7

From the review of the effectiveness of the Peer Review conducted, see recommendation 15 the SQEP register should also include an indication of the reviewers ability to add benefit to the safety argument in connection with the identification of the broader issues as well as consistency of the safety argument.

Recommendation 8

It is recommended that to supplement an individual reviewers past technical and project experience formal training is considered on the approach to be used by the reviewer to improve the quality and effectiveness of the review and how to provide an indication on the quality and thoroughness of the review. This would be in addition to the training currently given on the review process and this training should be formally identified in the SQEP register.

7.3 Scope and presentation of Peer Review

The scope of a Peer Review will dictate the extent of the coverage of the review and to a certain extent it will define the depth. However the scope will require

interpretation by the reviewers as to the depth of review and the extent of their comments.

To aid the review process it was found in some organisations, but not in all, that a visit to an existing plant should be made by the assessors. The purpose of the visit is to provide an immediate picture of the facility to inform the reviewer of the following points:

- the layout of the facility
- any difficulties with access for either operation or maintenance of the facility
- the general state of the plant with regard to any evidence of ageing or damage
- identify any hazards which are created by adjacent plant or other adjacent facility

This affords a greater impact on the reviewer's awareness of the facility, its strength and weaknesses, and thereby aid his understanding of the safety claims in the document. A recent facility visit should be part of the checks which govern whether the reviewer is SQEP for a given Peer Review.

In certain instances the nature of the facility does not allow access to or sight of the plant. In such cases discussions with the site staff as safety case owners should take place before the review is started with subsequent site visits as required to complete the Peer Review.

Several different definitions of the purpose of a Peer Review have been found. In essence they are the same where the Peer Review sets out to demonstrate that adequate safety arguments have been developed in the Safety Case documents using the professional judgement of an independent but suitably experienced peer. The definition only sets the scene but does not directly impact the effectiveness of the Peer Review.

The scope however does have a direct impact. This in all cases is defined by the Review Officer and agreed by the manager identified in Table 4. To help with the definition of the scope and the execution of the review a variety of check lists, top level topics and detailed topics have been found.

For example the top level would call for a check on completeness, the detailed level would call for a check on whether the external hazards had been adequately covered, and the check list would give a list of hazards requiring a 'Yes' or 'No' responses to a standard list of hazards such as fire, wind, missiles, extreme temperature, seismic etc. The high level topics will be represented in the detailed list of topics. The detailed check list sets down a predetermined list of topics many of which may not be relevant and some may be omitted. The scope of the review needs to provide focus but not to stifle the reviewer from considering broad issues hence the detailed topic list rather than the check list will benefit the effectiveness of the review.

The scope of the document to be reviewed needs to be understood before the scope of the review is defined. In many instances a meeting is called for between the document author and the Review Officer. This is a powerful way of quickly

identifying the overall approach adopted by the author and to reveal any contentious issues. This will also improve the relevance of the scope by limiting the detailed topics to those which are appropriate to the Safety Case document under review.

In all organisations, the comments from the reviewer are included in either a Peer Review report or documentation which formally tracks the Peer Review through to closure. A matrix of classes of comment are used to rank their seriousness. They also give a mechanism for indicating when the original comment has been resolved. Whilst there are differences in terms, there is a uniformity of purpose in that the categorisation or classification of the reviewers comments allows the importance of the comment to be conveyed to the author. This helps the process to resolve the reviewers comments but does not in itself have any influence on the quality of the review.

The common ground between organisations is found in the need for the review to identify the shortcomings and weaknesses. However the more positive comment which cites the strengths of the argument or the methods of analysis and assessment is not so frequently recorded but is of equal merit since the review is a commentary on the adequacy of the Safety Case in the document. This should be a feature of all Peer Reviews and would benefit the nuclear safety demonstration. However, there is no intent to promote the idea that positive comments can be used to balance out any adverse comments and that the closeout of shortfalls and omissions still require their complete resolution.

The close out of the Peer Review by the authors responses will be recorded in the Peer Review report. Where the resolution requires additional work then the system used by BEGL to record this on an outstanding work list is a good example of ensuring that final clearance of the Safety Case document will only take place when the work has been completed.

To resolve comments this will be a process of discussion between the Review Officer and the author and where resolution is difficult the Review Manager will be called upon to arbitrate. This arbitration will be recorded in the Peer Review report.

Once all the comments have been resolved, the issue of the Peer Review certificate can take place to demonstrate that the Safety Case in the document has been endorsed by the Peer Review.

The Safety Case is now presented to the Nuclear Safety Committee by the Safety Case owner. There is no consistency across the industry as to whether the Peer Review manager or the head assessor attends the NSC presentation. Also there is no consistency on the detailed information of the Peer Review which is passed on to the NSC. This may vary from a full Peer Review report to just an acknowledgement that the Peer Review has endorsed the Safety Case document by presenting the Peer Review certificate.

There was no evidence that this approach differed between Safety Cases which will be approved by the NSC and those which seek full approval from the regulator. However the route being adopted by AWE where the Peer Review was used as a

safety acceptance review shows a different approval route for different categories. In this plan the Director of Safety Assurance and the NSC would approve Category 3 and 4 Safety Cases respectively (the categories are shown in Table 3) and they would both approve Category 5 Safety Cases. The approved acceptance review would be forwarded to the NII either for their assessment or information depending on the category.

The strength of the endorsements of the Safety Case should be conveyed with the Safety Case as it progresses through the various stages to the NSC and the NII. This would benefit from being more than just a certificate however this should not necessarily be the whole Peer Review report. Also to ensure consistency the Peer Review manager or the Review Officer should attend the NSC to present a review summary.

Findings

Finding 12. A site visit to the plant is carried out in some organisations ahead of the scope definition phase and is beneficial to the specific detail in the scope.

Finding 13. A recent visit to the facility being reviewed was not identified as a part of the acceptance of a SQEP to be included in the review.

Finding 14. In some organisations a discussion between the Safety Case author and the lead reviewer takes place and has been found of great benefit during the initial stages of the review and how this relates to the scope of the peer review.

Finding 15. The ranking of comments occur throughout the industry and is seen as an aid to the resolution of comments but does not contribute to the effectiveness of the review.

Finding 16. The close out of the Peer Review does not portray the strength of the endorsement as the Safety Case progresses through its various approval stages. There is no guarantee that the Peer Review department attends the NSC when the Safety Case summary report is presented.

Recommendation 9

It is recommended that it is mandatory that the lead assessor and assessors have recently visited the facility being reviewed or have had discussions with the site staff who are the safety case owners.

Recommendation 10

The safety case document should be presented by its author to the reviewers at the start of the IPR after the scope of the review has been defined.

Recommendation 11

It is recommended that a more robust method than the Peer Review certificate is developed to portray the strength of the endorsement of the Safety Case. A more detailed assessment of the acceptance review should be undertaken as a possible vehicle to be used to meet this recommendation.

Recommendation 12

With a summary Peer Review accompanying the Safety Case document, the Peer Review Manager should attend the Nuclear Safety Committee along with the Safety Case owner.

7.4 Allocation of adequate time

In all the organisations assessed it was clear that the responsibility for the IPR was separate from that part of the organisation responsible for the safety case. The benefit from this structure was found in the requirement of the managers of the IPR to identify work loads and to plan the schedule for various steps of an IPR and to plan resource allocation. Whilst at a day to day working level adjustments to programmes will be required, the separate IPR management was shown to impose their requirements into the overall programme of the safety case to ensure adequate time was still being recognised for the IPR. This does not mean that the IPR is protected from the commercial environment and that dedication and commitment is expected to be applied equally to this activity involving the generation of the comments and their satisfactory close out as to all other activities.

The benefit cited in Finding 13 gained from the discussion between author and reviewer in defining the scope of the IPR were also found in closer definition of the extent of the document and the timescales likely to be required for the IPR. The presentation of the document to the reviewer to gain an overall appreciation to the approach adopted in the construction of the arguments used in the demonstration of the safety case will aid the review with a much more efficient start. In the same manner a presentation of the IPR comments to the author will more quickly bring an understanding to the issues and the resolutions required. Both of these approaches will bring more meaningful time to the review process without compromising the independence of the review and will prevent the lowering of the IPR standard because insufficient time is available for a remote process to be executed.

In several of the organisations a fixed period was placed in the programme at the start of the work to complete the IPR and as an end-activity could be under pressure to be curtailed. No evidence was found that indicated the Peer Review standard was threatened because of over-tight budgets or reduced timescales when the IPR process has been developed with close cooperation between the author and the reviewer.

Finding 17. In the cases where the IPR process has close involvement between the author and the reviewer, there was no evidence to show that the standard of the review had been threatened by the allocation of the inadequate timescales.

Finding 18. In all organisations it was found that the line management of the safety case generation was independent of the management of the review, but despite this division, time for the IPR activity was allocated in the programme and maintained throughout the project.

Recommendation 13

Presentation of the document to the reviewer by the author at the start of the IPR process and the resolution of comments through meetings makes the IPR process should take place as this is more effective and makes more efficient use of programme timescales.

Recommendation 14

To avoid the quality of the IPR being threatened by project or commercial pressures it is recommended that the time allowed for the IPR should be recorded in the overall assessment of the review given in recommendation 15.

7.5 Experience and feedback

On the question of what benefit had the Peer Review brought to nuclear safety there was no documented evidence.

The general impression given was that the Safety Case authors found the reviews in general brought an improvement in particular to the clarity and detail of the presentation of the safety arguments. No evidence was available which measured this improvement.

The intervention of the Peer Review which avoided a major breach of safety had not been experienced. However an example has been found where a Peer Review initiated an ALARP assessment which eventually showed a proposed modification to be a significant radiological risk during its instalment with little reduction in the risk from the modified facility.

The common pitfall in assessing the contribution of the peer review to improving safety is to use a simple quantitative approach based on either the total number of comments or the total number of the highest category of comments. This is generally misleading for the following reasons:

- There is no indication of the extent of the original document
- Commercial pressure particularly for independent consultants to portray value for money will provide the incentive to generate as high a number of comments as possible
- There is no indication of any duplication of the same issue included in different comments

- No indication is given as to the complexity of the content of the safety case document. The more complex area is likely to contain more contentious and original ideas which will be challenged by the peer review compared with accepted practices in the less complex document
- There is no indication of how the resolution of the comments will benefit the safety case.

Therefore it is suggested that in addition to the detailed comments generated by the reviewer, a part of the peer review process should be to summarise the complexity of the issues covered by the document indicating the quality of the original document. This quality assessment would then be repeated at the close out of the peer review process.

It is suggested that this summary would provide an indicator of the complexity of the issues using a ranking of A, B, C combined with a quantitative indication of the quality of the document. This could use the following definitions which are independent of the level of nuclear risk:

Complexity A – Safety Justification outside the normal standards requiring considerable levels of judgement with possibly outstanding issues

Complexity B – Safety Justification within normal standards requiring considerable levels of judgement

Complexity C – Safety Justification within normal standards requiring only minimal judgement

The overall assessment of the document quality would be measured on several parameters each with a mark between 1 and 10 where 1 is poor and 10 is excellent.

The following parameters could be used:

- Construction of the safety arguments
- Clarity of the scope and purpose of the document
- Relevance of the evidence used to make the case
- The quality of the data to support the case
- The soundness of any discussion supporting judgements
- The soundness of the evidence to support the conclusion

This alpha-numeric assessment summary would need to be approved by the Peer Review manager on the original version of the document as well as on the final version of the document. This would also provide evidence of the effectiveness of the

peer reviewer as well as a measure of the impact of the peer review process on the quality of the safety case.

As mentioned before a considerable amount of dialogue on Peer Review takes place within the nuclear industry which is aware of the standards being developed by IAEA, given in Ref 3. This dialogue is achieving common approaches in the execution of Safety Case Peer Reviews. While some improvements in uniformity is recommended it is difficult to identify how nuclear safety would be improved if a Peer Review standard existed.

Findings

Finding 19. No feedback exists on Peer Reviews which would measure the impact of Peer Reviews on nuclear safety.

Finding 20. With the common approach being adopted in the execution of Peer Reviews it is difficult to identify how a national standard for Peer Review would improve nuclear safety.

Recommendation 15

To investigate further parameters to be used to provide a summary indicator of the quality of the document and how this has been improved by the Peer Review process.

8 Summary of findings

Finding 1 Page 3

No International or National Nuclear Standard for Peer Reviews was found.

Finding 2 Page 3

Very little evidence on Peer Review feedback was found and no documents were found which indicated how a Peer Review of Safety Case documents had benefited the nuclear safety.

Finding 3. Page 8

The different styles of reviews have the same name. The same type of review has different names. This leads to confusion between the Licensee and the nuclear regulator on exactly what depth of review has been completed or is planned to be undertaken.

Finding 4. Page 10

The organisation set up to manage Peer Reviews is clear and unambiguous with equal recognition by senior management with the Safety Case generation. This should produce consistent quality to the Peer Review process.

Finding 5. Page 10

The category assigned to the safety document is helpful to the Peer Review process and the distinction between new plant and modifications helps to define the extent of the review. However the scope of the Peer Review is consistent across the range of safety case documentation.

Finding 6. Page 11

Using the numbers with different risk ranking could cause confusion in the NII.

Finding 7. Page 11

No guidance has been found on the categorisation of multiple simultaneous modifications.

Finding 8. Page 13

The Peer Review department sets out to assign the most appropriately experienced reviewer as the Review Officer. The Review Officer is expected to gather additional reviewers to cover specialist areas and areas of nuclear safety requiring specialist knowledge and experience.

Finding 9. Page 13

A SQEP register of reviewers is not held by anyone other than BEGL and the suitability of a person is mainly based on the judgement of the manager and the Review Officer.

Finding 10. Page 13

No formal record has been found in the SQEP registers of the effectiveness of the reviews carried out by individual reviewers in identifying the broader issues or consistency in the safety argument.

Finding 11. Page 13

There is generally no training given on how to review although BEGL were just introducing Peer Review training. However the training was on the review process and all organisations set down guidelines which show what areas to cover what questions to raise and what checks to make. Training on how to review, which is more on how is experience harnessed in a review, is a difficult aspect to resolve.

Finding 12. Page 16

A site visit to the plant is carried out in some organisations ahead of the scope definition phase and is beneficial to the specific detail in the scope.

Finding 13. Page 16

A recent visit to the facility being reviewed was not identified as a part of the acceptance of a SQEP to be included in the review.

Finding 14. Page 16

In some organisations a discussion between the Safety Case author and the lead reviewer takes place and has been found of great benefit during the scope definition stage.

Finding 15. Page 16

The ranking of comments occur throughout the industry and is seen as an aid to the resolution of comments but does not contribute to the effectiveness of the review.

Finding 16. Page 16

The close out of the Peer Review does not portray the strength of the endorsement as the Safety Case progresses through its various approval stages. There is no guarantee that the Peer Review department attends the NSC when the Safety Case summary report is presented.

Finding 17. Page 17

In the cases where the IPR process has close involvement between the author and the reviewer, there was no evidence to show that the standard of the review had been threatened by the allocation of the inadequate timescales.

Finding 18. Page 18

In all organisations it was found that the line management of the safety case generation was independent of the management of the review, but despite this division, time for the IPR activity was allocated in the programme and maintained throughout the project.

Finding 19. Page 20

No feedback exists on Peer Reviews which would measure the impact of Peer Reviews on nuclear safety.

Finding 20. Page 20

With the common approach being adopted in the execution of Peer Reviews it is difficult to identify how a national standard for Peer Review would improve nuclear safety.

9 Summary of recommendations

Recommendation 1 Page 8

An agreed title and definition of the independent review conducted by the Licensee before presenting the safety report to the regulator needs to be established and adopted by all UK nuclear site licensees.

Recommendation 2 Page 8

A study of the first level review should be conducted to establish its contribution to the quality of safety documents specifically to understand the management of the process and whether this achieves a consistent high standard of document to be presented for Independent Peer Review.

Recommendation 3 Page 11

Explore the benefits of a uniform numbering system for categorisation purposes throughout the industry.

Recommendation 4 Page 11

Guidance on categorisation principles to be followed when simultaneous modifications are taking place. This may apply also to decommissioning although if this is related to one project the coordination should capture any increase in risk.

Recommendation 5 Page 11

Identify mandatory key activities in the Peer Review process which should be recorded in the Peer Review procedures.

Recommendation 6 Page 13

To establish whether the SQEP register addresses aspects which have not been considered during the management selection of a suitable Review Officer. The objective being to make the selection of a Peer Reviewer a more rigorously assessed and traceable decision which would be part of the evidence included with the Peer Review approval certificate.

Recommendation 7 Page 13

From the review of the effectiveness of the Peer Review conducted, see recommendation 6 the SQEP register should also include an indication of the reviewers ability to add benefit to the safety argument in connection with the identification of the broader issues as well as consistency of the safety argument.

Recommendation 8 Page 13

It is recommended that to supplement an individual reviewers past technical and project experience formal training is considered on the approach to be used by the reviewer to improve the quality and effectiveness of the review and how to provide an indication on the quality and thoroughness of the review. This would be in addition to the training currently given on the review process and this training should be formally identified in the SQEP register.

Recommendation 9 Page 16

It is recommended that it is mandatory that the lead assessor and assessors have recently visited the facility being reviewed or have had discussions with the site staff who are the safety case owners.

Recommendation 10 Page 16

The safety case document should be presented by its author to the reviewers at the start of the IPR after the scope of the review has been defined.

Recommendation 11 Page 17

It is recommended that a more robust method than the Peer Review certificate is developed to portray the strength of the endorsement of the Safety Case. A more detailed assessment of the acceptance review should be undertaken as a possible vehicle to be used to meet this recommendation.

Recommendation 12 Page 17

With a summary Peer Review accompanying the Safety Case document, the Peer Review Manager should attend the Nuclear Safety Committee along with the Safety Case owner.

Recommendation 13 Page 18

Presentation of the document to the reviewer by the author at the start of the IPR process and the resolution of comments through meetings, makes the IPR process more effective and makes more efficient use of programme timescales.

Recommendation 14 Page 18

To avoid the quality of the IPR being threatened by project or commercial pressures it is recommended that the time allowed for the IPR should be recorded in the overall assessment of the review given in recommendation 15.

Recommendation 15 Page 20

To investigate further parameters to be used to provide a summary indicator of the quality of the document and how this has been improved by the Peer Review process.

10 Conclusions

From a literature survey and detailed discussions with Peer Review managers in the nuclear industry 17 findings were made on the affect of Peer Review on nuclear safety. A total of 8 recommendations have been made to benefit the delivery of safety from the Peer Review process.

Although no nuclear Peer Review standard exists common approaches have been identified that the benefit of creating a standard is difficult to identify.

The general findings showed that the Safety Case documentation benefits from being subject to a Peer Review particularly in the clarity of the safety arguments presented.

11 References

Ref	Title
1	Walkway Collapse at Port Ramsgate. HSE Book First Published 2000 ISBN 0 7176 1747 5
2	Procedure for the Preparation, Submission and Approval of the Site Nuclear Safety Justification for Those Sites Required to Conform to the Naval Base Authorisation Working Group (NBAWG) Recommendations. Annex A(1) to BR 3018
3	Impact of Peer Review on Safety at Nuclear Installations. Literature Review Summary Report. NNC Document C6011/TN/001, Issue 01, March 2000-06-27
4	ASCE Manual on Engineering Practice No. 73: Quality in the Constructed Project, 1988
5	Preparing Safety Reports: Control of Major Accident Hazards Regulations 1999. HSE Book ISBN 07176 1687 8

Ref	Title
6	IAEA-SVS-01 Guidelines for the Review of Research Reactor Safety Engineering Safety Section. IAEA, Vienna, Dec 1997
7	IAEA-TECDOC-543 Procedures for Conducting Independent Peer Reviews of Probabilistic Safety Assessment IAEA, Vienna, Oct 1989

Table 1 **Spread of review types**

Organisation	IPR	INSA
BEG Limited		T
BNFL Magnox Generation		T
UKAEA	T	
BNFL Sellafield		T
BNFL Springfield		T
BAE System Barrow	T	
AWE Aldermaston	T ⁽¹⁾	

(i) Adopting the term Acceptance Review

Table 2 Safety Case and Peer Review responsibilities

Organisation	Safety Case owner	Responsibility for Peer Review
BEGL	Specific Station Manager	Health, Safety and Environment Directorate – Nuclear Safety Department
BNFL-Magnox Generation	Specific Station Manager	Engineering Support Unit, Safety Assurance Section
UKAEA	Authority to Operate, ATO, holder	Safety Assessment Department
BNFL – Sellafield and Springfield	Plant Manager	Safety and Environment Risk Management
BAE Systems Marine	Astute Project/BAE Systems Nuclear Safety Manager	Nuclear Policy and Review Manager
AWE Aldermaston	Facility Manager for Aldermaston Site Manager for Burfield	Assurance Directorate – Head of Internal Regulation

Table 3 Nuclear risk category and Peer Review requirements

Nuclear category according to risk					Type of facility	Organisation adopting system
High risk		Low risk				
Mandatory Peer Review			Optional or no Peer Review			
	1	2	3		Nuclear Reactors	BEGL, BNFL Magnox, BNFL Sellafield
1	2	3	4		Nuclear Handling or Storage Plant	UKAEA
5	4	3	2	1	Nuclear Processing Storage Facilities	AWE
	A	B	C		Chemical Radioactive Process Plants	BNFL Sellafield and Springfield
A	B	C	D		Modifications to Nuclear Reactor Handling Facility	AWE BAE Systems UKAEA

Note: This table indicates the number of categories assigned by the organisations – not their relative importance or level of risk is different.

Table 4 The different Review Officer titles

Organisation	Manager	Review Officer
BEGL	Nuclear Safety Manager	Lead Assessor
BNFL Magnox Generation	Safety Assurance Section Manager	INSA Manager
UKAEA	Head of Safety Assessments Department	Head Reviewer
BNFL – Sellafield and Springfield	INSA Manager	Lead Assessor
BAE Systems Barrow	Review Manager	Lead Reviewer
AWE Aldermaston	Head of Internal Regulations	Acceptance Review Team Leader

Appendix A - Detailed plan of issues to be raised in the discussions on Peer Review Practices

(a) Standards

Do you have a formal Review Policy?

If not, what guidance do you provide for the performance of Peer Reviews?

If you have a formal policy, do you have any Company Standards for the performance of Peer Reviews?

(ask for copies of relevant documents)

If so, do they reference any National or International Standards or Guidelines?

What types of Peer Review do you carry out?

Do you have a definition of 'Peer Review'?

(b) Organisation

Who in your organisation is responsible for the performance of Peer Reviews?

Do you have a separate group performing Peer Reviews, or do you use individuals inside and/or outside the company?

Do you use Peer Review Co-ordinators for larger, multi-disciplinary Peer Reviews?

(c) Reviewer selection

Independence

Who decides which reviewer will perform a Peer Review?

What controls do you have in place to ensure that a Peer Reviewer is independent?

Do you give guidance to Peer Reviewers on how to remain objective and independent?

Qualification/competence

Do you have documented qualification/competence requirements for Peer Reviewers?

Who decides that an individual is qualified to perform a Peer Review, i.e. do you have a SQEP process?
(i.e. station vs. discipline requirements)

Do you keep a central list of Peer Reviewers?

Do you review the performance of Peer Reviewers?

What do you see as more important, independence or qualifications/competence, and why?

Training

Do Peer Reviewers receive training on how to perform a Peer Review?

If so, what training do they receive?

Do you have any requalification requirements for Peer Reviewers?
(i.e. how do they keep up to date with changing regulations, Operating Rules, Standards etc.)

(d) Scope

Do you have documented requirements on what the scope of a Peer Review should be?

If not, how does the scope get established?
(process, approval of scope etc.)

Do you have different levels of Peer Review Requirements, depending on safety significance, complexity, impact etc.?

Do you have a pre-determined time for performing different levels of Peer Reviews, if so how long do you expect a Peer Review to take?

(e) Procedure

Do you have a procedure defining how to perform a Peer Review?

Does the reviewer use checklists, or does he have general guidance on what to do?

At what stage in the life of the original work is a Peer Review performed?

(i.e. too early runs risk of becoming part of original process, too late could be impacted by non-availability of personnel)

Does the Peer Reviewer know the name of the author of the original work?

Does the original author know who will be performing a Peer Review on his work?

Does work that has been Peer Reviewed get presented to a nuclear safety committee?

(f) Reports

Does the Peer Reviewer have to produce a formal report?

Who is given the Peer Reviewers report?

(what about the nuclear regulator?)

Is a Peer Review report vetted before publication, if so by whom, and what is the purpose of the vetting?

Do you have any guidance on what type of feedback is suitable?

(i.e. +ve vs. -ve critique, how is this covered)

Does the Peer Review report become part of the Safety Case records?

(g) Corrective actions

Responses

How is the dialogue between the originator and the Peer Reviewer controlled?

(i.e., responses going to and fro, cut-off point, mutual disagreement etc.)

Tracking

Are recommendations made during a Peer Review actioned and tracked to completion?

Close-out

Are any recommendations made during a Peer Review closed out?

If so, who closes the corrective actions?

Is the Peer Reviewer given the closed out action to review for adequacy, does he endorse the original work?

When do corrective actions have to be closed out by?

(h) Experience

Have you seen any benefits from performing Peer Reviews?

(need examples)

Do Peer Reviews usually have enough time allocated to them?

Have you had any specific benefits or hindrances from performing Peer Reviews?

Would you see any benefit from having common industry standards/guidelines for Peer Reviews? like to see regulatory guidance on Peer Reviews?