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Title:	Approval Under Licence Condition 23(5) for an Amendment to Technical Specifications, Safety Limits and Nuclear Safety Requirements, Section 2.3.3, 'Instrumentation' and Table NSR 3.2-1 in Particular		
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Removal of Reference to Redundant CO_2 Monitoring Panels from Technical Specifications

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EXECUTIVE SUMMARY

Title

EdF Energy Nuclear Generation Ltd (EdF NGL) – Sizewell B (SZB) Power Station – Licence Instrument 547 – Approval for an Amendment to Technical Specifications, Safety Limits and Nuclear Safety Requirements, Section 2.3.3, 'Instrumentation' and Table NSR 3.2-1 in Particular.

Permission Requested

Under Licence Condition 23 of the conditions attached to the relevant Nuclear Site Licence, the licensee is required to have a safety case for all operations which may affect safety and to identify limits and conditions derived from the safety case (which are referred to as Operating Rules - OR). Operating Rules for nuclear power stations have been approved by the Office for Nuclear Regulation (ONR) and once approved these Operating Rules are 'frozen'. Any subsequent proposed changes, to the 'frozen' Operating Rules, have to receive ONR's approval before the proposed changes can be made and implemented. At Sizewell B the licensee (i.e. EdF Energy Nuclear Generation Ltd – EdF NGL) wishes to change an Operating Rule (known as Technical Specifications or Tech Specs at Sizewell B). The change requested by the licensee relates to the deletion from the Technical Specifications of mention of redundant carbon dioxide monitoring panels in the Sizewell B Main Control Room (MCR). Accordingly, the licensee has formally sought ONR's approval to make this change under Licence Condition 23(5) of its Nuclear Site Licence (No. 63) for Sizewell B.

Background

The four carbon dioxide detectors, currently installed in the Heating and Ventilation Air Conditioning (HVAC) ducts feeding the Sizewell B Main Control Room (MCR), were originally installed to mitigate against potential rupture of a number of bulk carbon dioxide storage tanks located on the adjacent Sizewell A nuclear power station site, which contained a large quantity of carbon dioxide. The Sizewell B Station Safety Report (SSR) predicted that in the unlikely event that this entire stored carbon dioxide inventory was released then it could pose a potential hazard in the Sizewell B Main Control Room. The carbon dioxide detectors were hence installed in the ducting, feeding the Sizewell B Main Control Room, to both detect any carbon dioxide entering the ducting and to automatically isolate the Heating and Ventilation Air Conditioning to the Main Control Room (thus protecting the control room operators from the gas release). The detectors in turn feed signals to monitoring panels, located in cabinets, in the Main Control Room.

However, Sizewell A is now in decommissioning and all bulk carbon dioxide has been removed from the site (i.e. both from the stock tanks and from the reactor coolant circuits, which are now in an air atmosphere). There are no future envisaged requirements to re-introduce any bulk quantities of carbon dioxide back onto the Sizewell A site.

Notwithstanding the removal of bulk carbon dioxide stocks from Sizewell A, the licensee has recognised that there is also a carbon dioxide stock tank on the Sizewell B site. This Sizewell B stock tank is still in use, although it contains a much smaller quantity of carbon dioxide. Rupture of this tank could also pose a potential threat to personnel in the Sizewell B Main Control Room. Accordingly, the licensee has presented a safety case to demonstrate that should all the carbon dioxide be released from the tank then, even based on conservative assumptions, it will not result in hazardous levels of carbon dioxide in the Main Control Room.

It is on the basis of its safety case, analysing potential carbon dioxide levels in the Main Control Room from an assumed rupture of the stock tank on the Sizewell B site, that the licensee has submitted its request to ONR to remove mention of the redundant carbon dioxide

monitoring panels from the Tech Specs. The safety case is not, however, intended to justify physical removal of the carbon dioxide detectors from the ducts (this will be the subject of a separate future safety case).

The licensee has also recognised that isolation of the redundant carbon dioxide detectors could in time lead to spurious signals on the associated monitors in the Main Control Room (which could be a distraction to the control room operators). Accordingly, the licensee has also presented a second safety case, to be implemented at the same time as that justifying non-hazardous carbon dioxide levels in the Main Control Room, which will allow the power supplies to the detectors and their monitor cabinets to be isolated and will also engineer 'healthy' signals to the Primary Protection System (PPS), High Integrity Control System (HICS) and the Distributed Computer System (DCS). ONR has also considered the licensee's second safety case, to ensure the modifications to be made within its scope do not pose any potential threat to nuclear safety.

The purpose of this report is to summarise ONR's assessment work, on the licensee's two safety cases (as described above), to justify the issue to the licensee of an Approval under ONR's primary powers (as requested by the licensee) to allow removal of references in the Technical Specifications to the redundant carbon dioxide monitoring panels.

Assessment and inspection work carried out by ONR in consideration of this request

In assessing the licensee's request, for removal of reference to the carbon dioxide monitoring panels from the Tech Specs for Sizewell B, ONR:-

- Studied the licensee's documentation relating to its two safety cases (described above).
- Commissioned an ONR specialist, in gaseous dispersion modelling, to provide an assessment to the accuracy and validity of the calculations the licensee presented and which form the basis of its safety justification.
- Obtained advice from an ONR specialist Control and Instrumentation (C&I) inspector as to the validity and acceptability of the arguments the licensee has made in its second safety case (to engineer 'healthy signals' to a number of identified safety related computer systems – see above).
- Engaged with the licensee to seek clarification of some aspects of its two safety cases.
- Studied the licensee's Quality Plan (QP), for implementation of its overall strategy with respect to the redundant detectors and monitor cabinets.

ONR was content from the work it has conducted that the licensee has presented an adequate overall safety case and has demonstrated that their proposed course of action meets the As Low As Reasonably Practicable (ALARP) principle. ONR hence recommended that approval be granted to Sizewell B to make the requested deletion in the Technical Specifications.

Matters arising from ONR's work

All matters ONR raised with the licensee, as a result of its assessment work, have been resolved to ONR's satisfaction and accordingly there are no outstanding matters arising.

Conclusions

Under its Licence Condition arrangements, the licensee submitted a detailed Category 3 safety justification, supporting its request to permit the necessary changes to the Technical Specifications to delete reference to the now redundant carbon dioxide monitoring panels.

This safety justification successfully completed the licensee's own due process, with no residual reservations. ONR has subjected the licensee's safety submission (in support of its request) to detailed scrutiny and has obtained advice from an ONR specialist in gaseous dispersion modelling, who has endorsed the licensee's calculations which form its main safety justification. ONR has also engaged directly with the licensee on a number of specific points in its safety submission and in all cases has received satisfactory responses from the licensee.

In addition, ONR sought advice from an ONR Control and Instrumentation specialist on a second safety case presented by the licensee, which supports isolation of power to both the carbon dioxide detectors and the associated monitors and the engineering of 'healthy' signals in a number of key safety related computer systems. It is intended that this second safety case will be implemented at the same time as the first safety case (thus avoiding the potential for spurious indications on the carbon dioxide monitors in the Main Control Room and a standing isolation of the Heating and Ventilation Air Conditioning). Based on the advice provided by the ONR specialist, ONR is satisfied that the licensee had produced an adequate safety submission for the changes proposed in this second safety case. There are hence no technical or regulatory reasons to prevent ONR approval being given to the licensee's proposed changes to the Technical Specifications.

Recommendation

Permission should be granted to the licensee, via the issue of Licence Instrument 547 (Approval), to make the required changes to the Technical Specifications (Tech Specs), required to delete reference to the now redundant carbon dioxide monitoring panels.

In the context of Licence Instrument 547 and following a detailed study of ONR's records (i.e. of previous Approvals issued to Sizewell B), it was apparent that the issue of Licence Instrument 547 will require consequent modification to Approval No. 4 (dated 24th April 2002) to the extent necessary to effect Approval 547. It is recommended that this change is implemented coincident with the issue of Licence Instrument 547.

LIST OF ABBREVIATIONS

ALARP	As Low As Reasonably Practicable
BMS	Business Management System
C&I	Control and Instrumentation
CNS	Civil Nuclear Security (ONR)
CO_2	Carbon Dioxide
DCS	Distributed Computer System
EA	Environment Agency
EC	Engineering Change
EdF NGL	EdF Energy Nuclear Generation Ltd
HICS	High Integrity Control System
HOW2	(Office for Nuclear Regulation) Business Management System
HSE	Health and Safety Executive
HVAC	Heating and Ventilation Air Conditioning
IAEA	The International Atomic Energy Agency
INSA	Independent Nuclear Safety Assessment
LC	Licence Condition
LI	Licence Instrument
MCR	Main Control Room
NSC	Nuclear Safety Committee
NSR	Nuclear Safety Requirement
ONR	Office for Nuclear Regulation
OR	Operating Rule
PAR	Project Assessment Report
ppm	Parts Per Million
PPS	Primary Protection System
QP	Quality Plan
RGP	Relevant Good Practice
SAP	Safety Assessment Principle(s)
SSG	Site Stakeholder Group
SSR	Station Safety Report
SZA	Sizewell A
SZB	Sizewell B
TAG	Technical Assessment Guide (ONR)
Tech Spec	Technical Specification
WEL	Work Exposure Limit

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1 PERMISSION REQUESTED

1. The licensee i.e. EdF Energy Nuclear Generation Ltd (NGL) has submitted a request (Reference 1) to delete reference in its Operating Rules (OR), known as Technical Specifications or Tech Specs, to a number of now redundant carbon dioxide (CO_2) monitoring panels located in the Sizewell B (SZB) Main Control Room (MCR). However, since the licensee's request requires amendment to the existing approved SZB Tech Specs i.e. Section 2.3.3, 'Instrumentation' and table Nuclear Safety Requirement (NSR) 3.2-1 in particular, then the licensee has applied, under its arrangements made under Licence Condition LC 23(5) of Schedule 2 of Nuclear Site Licence No. 63, for Approval from the Office for Nuclear Regulation (ONR) to amend the SZB Technical Specifications (constituting a modification to the Approval Notice No. 4 dated 24th April 2002).

2. A detailed study of ONR records has been carried out to confirm that no other modifications (i.e. apart from the required modification to Approval No. 4 noted above), or deletions, to extant ONR Licence Instruments (LI) for SZB, will be required as a result of implementing LI 547.

3. This single ONR Project Assessment Report (PAR) presents the basis for the decision by ONR to issue Licence Instrument 547 (Approval) to permit the licensee to delete mention of the now redundant CO_2 monitoring panels from the SZB Tech Specs.

4. Due to the categorisation of the licensee's two safety cases supporting its request (both are Category 3 signifying a low safety significance), plus the fact that the safety cases are both short, the ONR Delivery Lead has taken a decision (Reference 2) that it is proportionate to issue only a PAR to support ONR's decision (i.e. there is no requirement for detailed ONR Assessment Reports to be produced to underpin the PAR), although the PAR does reference an assessment note and a number of e-mails providing advice from ONR specialists with the associated Professional Lead consultation, which underpin the conclusions of the PAR.

2 BACKGROUND

5. The SZB Station Safety Report (SSR) – 'Protection Against Miscellaneous Hazards' recognised that the storage of CO_2 (in 8x CO_2 stock tanks on the Sizewell A - SZA site) was a potential hazard to the SZB site, due to the quantity of CO_2 being stored (circa 732 te). It was predicted that in the unlikely event that all of this inventory were to be released, then CO_2 concentrations could be of the order 16.5% by volume at the intake to the Heating and Ventilation Air Conditioning (HVAC) to the SZB Main Control Room (MCR) i.e. well above the Health and Safety Executive (HSE) Work Exposure Limit (WEL) of 0.5% by volume.

6. Accordingly, CO_2 monitors (4 of) were installed in the HVAC ducts and connected to monitors in cabinets in the MCR. The system was intended to automatically detect the CO_2 gas release hazard (should it occur) and to isolate the HVAC so as to protect the operatives in the MCR.

7. However, SZA is now being decommissioned and all the CO_2 stock tanks have been emptied and the SZA reactors are now in air i.e. there is no bulk CO_2 remaining in the reactor circuits. In addition there is no identified need to re-introduce bulk CO_2 stocks onto the SZA site in the future.

8. Accordingly, it would seem that the CO_2 detectors and monitors are now redundant. However, the licensee has recognised that the SZB site itself also has a CO_2 stock tank (although the volume holding for this tank is only circa 6 te i.e. very much less CO_2 is stored than was originally stored on the SZA site). Nonetheless, should a

catastrophic rupture of this stock tank occur and the gas disperse, the licensee has accepted that it could also pose a hazard to personnel working in the SZB MCR if it were to diffuse and enter the MCR HVAC inlet duct.

9. The licensee has hence presented a safety case to ONR (Reference 3) in which it has estimated the likely effects at the SZB MCR of a catastrophic failure of the SZB CO_2 stock tank. However, the safety case is not intended to justify actual removal of any of the equipment, merely to justify deletion of reference to the now redundant CO_2 monitors in the SZB Tech Specs. [Appropriate and consequent deletions will also be made in station instructions, drawings etc.]. Actual removal of the CO_2 detectors from the HVAC ducts will be the subject of a separate future safety case.

10. The licensee has also recognised that if the CO_2 monitors in the MCR cabinets (which are obsolete and are becoming increasingly unreliable) are just left marked 'Redundant' and their maintenance is suspended as a result of implementation of Reference 3, then instrument drift could occur in time. Instrument drift could be an unwanted distraction to operators in the MCR and lead to a standing MCR HVAC isolation actuation demand and bad analogue input alarms. In addition, the associated Surveillance Test Procedures for the CO_2 monitors (i.e. to prove their ongoing operability) generate a significant maintenance burden, which will also be relieved by making the changes proposed in the following paragraph.

11. Accordingly, the licensee has also produced a second safety case (Reference 4), whose intention is to justify the installation of links (i.e. using resistors and shorting links) in the CO_2 monitor cabinets to provide a 'healthy' signal to the Primary Protection System (PPS)/High Integrity Control System (HICS) and to the Distributed Computer System (DCS) to avoid spurious CO_2 alarms until the associated software for these systems has been modified (which will be the subject of separate future safety cases). The licensee has confirmed (i.e. in Reference 24) that the implementation of Reference 4 will not affect the ability of the PPS to provide an HVAC isolation, as the same isolation signal is also generated on 'High MCR Smoke' (for which the associated detectors are not affected by Reference 4). Additionally, if the hardware modifications of Reference 4 were to degrade and fail, then the ability of the PPS to initiate an HVAC isolation remains i.e. the PPS is still monitoring CO_2 levels and will respond accordingly, however the CO_2 input signal it monitors will remain fixed and will no longer indicate genuine CO_2 levels. The licensee's intention is to implement this second safety case (i.e. Reference 4) at the same time as Reference 3 (i.e. within one shift – Reference 5, Section 1.2).

12. The purpose of this Project Assessment Report (PAR) is to report the findings of my assessment of the licensee's two safety submissions (i.e. References 3 and 4) justifying the removal of reference to the now redundant CO_2 monitors in the SZB Tech Specs.

3 ASSESSMENT AND INSPECTION WORK CARRIED OUT BY ONR IN CONSIDERATION OF THIS REQUEST

3.1 STANDARDS AND CRITERIA

13. I have carried out assessment of Reference 3 and in addition have sought advice from ONR specialist assessors on the validity of the licensee's gaseous dispersion modelling (which forms the main basis of the licensee's safety case). In the case of Reference 4, I did not assess the licensee's documentation as I considered the licensee's safety case to lie outside my area of technical expertise. Instead, I obtained advice from an ONR specialist Control and Instrumentation (C&I) inspector, as to the validity and acceptability of the arguments made by the licensee in Reference 4.

14. My assessment strategy for the licensee's two Category 3 safety cases i.e. References 3 and 4, supporting the licensee's proposal to delete references to the now redundant CO_2 monitors in the SZB Tech Specs, is set out in this section. The scope of the assessment and the standards and criteria, against which the licensee's safety submissions have been judged, are identified.

15. Assessment was undertaken in accordance with the requirements of ONR's HOW2 Business Management System (BMS) – "Guide – Purpose and Scope of Permissioning," Reference 6. The relevant standards and criteria, adopted within my assessment, were principally the Safety Assessment Principles (SAP), Reference 7. Specifically, the following SAPs were used in my assessment:-

SAP SC.1 – The Regulatory Assessment of Safety Cases – Safety Case Production Process.

SAP SC.4 – The Regulatory Assessment of Safety Cases – Safety Case Characteristics.

SAP SC.5 – The Regulatory Assessment of Safety Cases – Optimism, Uncertainty and Conservatism.

SAP ST.6 – Siting – Multi-Facility Sites.

SAP EHA.14 – Engineering Principles: External and Internal Hazards – Fire, Explosion, Missile, Toxic Gases etc. – Sources of Harm.

SAP AV.2 – Fault Analysis: Assurance of Validity of Data and Models – Calculation Methods.

SAP AV.6 – Fault Analysis: Assurance of Validity of Data and Models – Sensitivity Studies.

16. In addition I also consulted ONR Technical Assessment Guide (TAG) NS-TAST-GD-042 (Reference 8) in my assessment of Reference 3. Finally, I note that I have utilised the information in the HSE document on "Approved Workplace Exposure Limits", (Reference 9) in making my judgements with respect to the licensee's calculated levels of CO_2 in the SZB MCR.

17. This project assessment report has been up issued to revision 1 following an initial review of the PAR by the Deputy Chief Inspector CNRP. The DCI noted that the original supporting specialist inspector's advice had not been copied to the relevant Professional Leads as required by ONR's permissioning process guidance (Reference 25). This revision of the PAR now incorporates appropriate peer review of the original E, C&I advice by the E, C&I Professional Lead (Reference 26) and an additional specialist review of the vapour cloud dispersion modelling undertaken on behalf of the Internal Hazards Professional Lead (Reference 27). Two additional references have been included to provide an auditable trail of the inclusion of the appropriate Professional Lead consultation, as required by ONRs' guidance. Both of the additional reviews undertaken support the original advice given in revision 0 of the PAR (Reference 28) and hence provide further confidence in the regulatory recommendation given in this PAR. The changes made by the author of this revision 1 of the PAR, are the incorporation of reference to the additional two reviews undertaken as outlined in paragraphs 36 and 42 with their respective TRIM file references added to section 7.

3.2 COMPLETION OF LICENSEE'S DUE PROCESS

18. Prior to undertaking my assessment, I confirmed that the licensee's safety submissions (References 3 and 4) had completed the licensee's due process (noting from Reference 10 that there is no requirement for Reference 4 to be subjected to the licensee's Independent Nuclear Safety Assessment – INSA process, or to receive scrutiny from the licensee's Nuclear Safety Committee – NSC).

19. Reference 3 is the key reference, supporting the licensee's request to delete references in the Tech Specs to the now redundant CO_2 monitors. Reference 3 is a Category 3 safety case, but as it supports a change to an OR the case has been subjected to INSA. The INSA record (Reference 11) confirms that the INSA Engineer was content with the safety case and with the licensee's proposed changes to the Technical Specifications.

20. Reference 3 has also been presented to the licensee's NSC, Reference 12 and the committee noted the changes to the NSR and the categorisation of the changes presented. Only one minor editorial comment was made by the NSC (Reference 14).

3.3 ONR ASSESSMENT OF REFERENCE 3

21. The licensee's main argument, to justify the removal of reference to the redundant CO_2 monitors in the SZB Tech Specs, is that the key hazard the monitors and associated detectors were originally installed to protect against (i.e. the large volumes of CO_2 stored on the adjacent SZA site, circa 732 te in the 8x CO_2 stock tanks, plus the CO_2 contained in the SZA reactor cores) has now been removed from the SZA site. The licensee has also asserted that there are no currently identified requirements to re-introduce significant volumes of CO_2 back onto the SZA site in the future and that suitable mechanisms are in place to forewarn SZB should any requirement, to introduce bulk CO_2 stocks back onto the SZA site, emerge in the future.

22. I sought additional information from the SZB licensee (Reference 13) as to the robustness of the arrangements to forewarn SZB of bulk gas re-introduction onto the SZA site and the licensee assured me (Reference 14) that, in the unlikely event that bulk CO_2 had to be re-introduced onto the SZA site, then:-

- SZB station staff would be made aware via the quarterly Site Stakeholder Group (SSG) meetings.
- There are periodic inter-site liaison and cross site contract meetings between the SZA and SZB sites.
- SZA's Engineering Change (EC) process challenges any modification with regards to its potential effect on SZB.
- Any requirement to re-introduce bulk CO_2 onto the SZA site would be communicated to the ONR Site Inspector for SZA.

23. Accordingly, the licensee is convinced, based on the regular meetings and the EC process prompt, that the process of informing SZB of any requirement to re-introduce bulk CO_2 onto the SZA site is robust. I accept the licensee's judgement in this respect and hence am of the opinion that SZB would have adequate time to take suitable and sufficient mitigating measures (if required) should bulk CO_2 stocks be re-introduced to the SZA site.

24. However, Reference 3 also recognises that the SZB site itself has a single CO_2 bulk storage tank, albeit of only 6 te capacity. Accordingly, in Reference 3, the licensee presents calculations to estimate the likely CO_2 levels at the SZB MCR should the 6 te

CO_2 storage tank on the SZB site fail catastrophically. In Reference 13 I questioned the licensee as to the ongoing requirements at SZB for this CO_2 tank. I was assured by the licensee (see Reference 14) that the CO_2 tank at SZB supplies CO_2 to the SZB Turbine Hall (for use as a purge gas in the turbine generator gas control system). Accordingly, I am convinced that the CO_2 tank at SZB fulfils an important operational purpose and hence cannot be removed to mitigate any potential hazard at the SZB MCR.

25. I have noted the requirements of the Control of Substances Hazardous to Health (COSHH) regulations (Reference 15) and hence have compared the licensee's calculations (presented in Reference 3) against the defined Workplace Exposure Limits (WEL), Reference 9, for a 15 minute reference short-term exposure to CO_2 of 15,000 parts per million (ppm) (i.e. approximately 1.5%) and a long-term (defined as 8 hours) WEL of 5,000 ppm (i.e. approximately 0.5%).

26. In its first calculation (presented in Reference 3), the licensee has taken the original calculations (for release of CO_2 from all 8 of the SZA stock tanks), which estimated that this could result in a concentration of circa 16.5% at the SZB MCR HVAC vent intake. Since this calculated concentration resulted from an assumed release of circa 732 te of CO_2, then the licensee simply factored the calculated concentration by the relative volumes of the SZA and SZB CO_2 tanks to provide an estimate for the release from the SZB tank of circa 0.14%. I share the licensee's view, however, that this calculation may be overly simplistic.

27. Accordingly, the licensee has further developed its analysis by applying the methodology used for the original SZA hazard assessment, which calculated the volume of the cloud of CO_2 and air mixture and converted this volume into a cube to allow estimation of the CO_2 cloud height. The concentration of the CO_2 in the cloud was then calculated. The licensee concedes that the detail, of how the CO_2 cloud height and concentration was originally used to determine the gas concentration of the dispersed cloud at the mouth of the intake for the MCR HVAC, is missing but the licensee has interpreted the discussion in the original supporting references and has demonstrated that it can recreate the original SZA calculations with a reasonable degree of accuracy.

28. Subsequent application of this methodology, to the SZB stock tank case, yields a calculated CO_2 concentration, at the mouth of the HVAC intake, to be 1.1%. This calculated value is clearly in excess of the long term WEL of 0.5% (although meets the short-term WEL limit).

29. However, the licensee has asserted that its calculation has some significant inherent pessimisms i.e.

- Most of the solid CO_2, released on tank rupture, is assumed to instantaneously form the vapour of the gas cloud. This would only occur if the solid were present as very finely divided particulate and disperses simultaneously displacing the air above and around the tank. In reality it would take time for the air to mix with the CO_2 cloud and for the particulate to sublime as the heat transfer occurs with the air.
- The calculation makes no allowance for the presence of moisture in the air, which would condense then freeze and thus reduce the cloud size, although it would increase the CO_2 concentration.
- The vapour cloud has been approximated by a cube, but if a hemi-spherical shape of the same volume were to be assumed instead, then the cloud height would be circa 80% that of the cube. However, if the cloud shape were assumed to be a right cylinder, or sphere, then its height would be circa 108%

of the cube of the same volume. Accordingly, for rupture of all 8 SZA CO_2 tanks, the height of the vapour cloud will always be above that of the MCR HVAC intake duct. However, in the case of the SZB tank, located some 3.1 metres below the level of the SZA tanks, the cloud height (for all assumed shapes) would lie below the MCR HVAC intake.

- The 8x SZA tanks have been assumed in the calculation to be a single large tank, which is physically unrealistic (in reality the tanks form two long banks of tanks with the nearest tank being approximately 224 metres from the HVAC intake and the furthest being approximately 250 metres from the intake).
- The wind direction at the time of rupture has been assumed to be in the direction of the HVAC intake.
- The wind speed assumed was that required to move the cloud but not to disperse it significantly. The assumed wind speed is of importance, as for a zero wind speed, the cloud would not reach the intake before it slumped. For the assumed wind speed of 5 metres/second the cloud would take approximately 36 seconds to reach the intake and would take circa 4.2 seconds to pass it (lower wind speeds conversely would take longer to reach the intake but also longer to pass it). For greater wind velocities the cloud would take less time to both reach and pass the intake but dilution of the cloud by turbulence would increase.
- Buildings and architectural features, between the ruptured tank and the intake, have been assumed to have no influence on the CO_2 cloud. However, the licensee has noted that between the tank and the intake there are a number of buildings, which would greatly perturb the CO_2 cloud (although concedes that this would be difficult to quantify). The presence of a parapet bounding the MCR building roof would also provide protection from the cloud.

30. On the basis of all of the above assumed conservatisms, the licensee has judged that it is very unlikely that the CO_2 concentration would reach 1.1% or indeed exceed the 0.5% CO_2 8 hour WEL limit at the intake.

31. Vapour cloud dispersion and its modelling lies outside my areas of technical expertise, but in my opinion the licensee has adequately justified that there are multiple conservatisms within its calculation. In particular, I find the argument that the vapour cloud height (from the assumed ruptured SZB CO_2 tank) will actually be lower than that of the HVAC intake to be persuasive. I also note that the actual margin, between the calculated CO_2 concentration and the long term expose WEL, is small and I concur with the licensee's view that in reality the actual CO_2 concentration is unlikely to approach the value calculated. Finally, I note that the calculated CO_2 concentration does not exceed the short-term WEL of 1.5% (which is the more applicable limit in this case as the cloud will only take a short time to pass the intake location).

32. Notwithstanding, the licensee has presented a final additional argument that should the CO_2 concentration be as calculated at the MCR HVAC intake (i.e. circa 1.1%) and takes circa 4 seconds to pass the intake, then the volume of gas entering the MCR would be diluted over the MCR volume and would hence give a CO_2 concentration in the MCR substantially below the 8 hour WEL (i.e. circa 0.03% compared to the 0.5% limit).

33. The licensee's safety case (i.e. as presented in Reference 3) in my opinion lacked a robust justification that the safety case complied with the As Low As Reasonably Practicable (ALARP) principle and I communicated this view to the licensee in Reference 13. The licensee has subsequently supplied an ALARP statement and has added this to the "Implementation Milestone" for Reference 3. This ALARP statement i.e. Reference 16 states that:- "The removal of the monitors from the Tech Specs is justified on the basis that the CO_2 hazard from SZA no longer exists, as bulk CO_2 is no

longer stored on the site. Small amounts of CO_2 are stored on the SZB site, but in insufficient quantities to pose a risk to occupants of the MCR. The EC is judged to make the best use of available resource and provides a safe resolution, whilst ensuring that there is no degradation to nuclear safety and that configuration control is maintained. The EC accordingly substantiates an overall ALARP position." I am content with this ALARP statement and hence that the licensee's safety case, as presented in Reference 3, satisfies the ALARP principle.

34. However, as noted above, vapour cloud dispersion lies outside my area of technical expertise and accordingly, I sought advice from an ONR specialist in this field. The ONR specialist's view (Reference 17) was that the licensee had used a convoluted method in its calculation. Accordingly, the ONR specialist performed an alternative calculation using a Gaussian plume model for the CO_2 dispersion from the SZB stock tank. The full details of the calculation itself are provided in Reference 17 but the ONR specialist's conclusion was that the CO_2 concentration at 189 metres from the SZB stock tank (the approximate location of the mouth of the HVAC intake) would be circa 1% and the plume passage time (for an assumed wind velocity of 2 metres/second) would be of the order of a few minutes.

35. In my opinion this ONR cross-check calculation provides a good independent confirmation of the licensee's work and demonstrates that the short-term WEL limit of 1.5% would not be breached (the short-term limit is applicable here as the gas cloud would have passed the vent intake after a number of minutes i.e. less than the WEL assumption of 15 minutes).

36. However, the ONR specialist also decided to perform one additional calculation using a more exact method, Reference 18 and full details of the calculation performed are available in this reference. From this additional calculation the ONR specialist judged that the concentration of CO_2 in the MCR would not exceed the short-term WEL limit of 1.5%. In my opinion this adds further confidence to the work conducted by the licensee. The work conducted by the license has also been reviewed by a second ONR specialist assessor under the direction of the ONR Internal Hazards Professional Lead. The assessment note concludes that the licensee's calculations of carbon dioxide hazard range are very conservative in comparison with HSE current good practice and that, from an internal hazards perspective, there is no reason to reject the licensee's proposal to remove the CO2 monitoring panels from the tech specs. The ONR Internal Hazards Professional Lead has reviewed the assessment note and supports the findings and conclusions reached (Reference 27).

37. In conclusion, therefore, I am content with the safety case the licensee has presented in Reference 3 and hence support the issue of the requested LI to allow reference to the redundant CO_2 monitors in the SZB Tech Specs.

3.4 ONR ASSESMENT OF REFERENCE 4

38. The licensee has recognised that if the CO_2 monitors in the MCR cabinets are just left marked redundant and their maintenance is subsequently suspended, then in time instrument drift will occur. Instrument drift could be an unwanted distraction for operators in the MCR (as well as leading to a standing MCR HVAC isolation actuation demand and bad analogue input alarms). Accordingly the licensee has also presented a second safety case (i.e. Reference 4) to justify the installation of resistors and shortening links (in the CO_2 monitoring cabinets) to provide a healthy signal to the PPS, HICS and DCS. The installation of these hard-wired links will avoid spurious CO_2 alarms until the associated software for these systems can be modified (to be justified in a separate future safety case).

39. Recognising that Reference 4 discusses hardware changes, which have a potential to impact upon safety related computer systems and that I am not a Control and Instrumentation (C&I) specialist, I sought assistance from an ONR C&I inspector in reviewing the safety case presented by the licensee in Reference 4.

40. In assessing Reference 4, the ONR specialist C&I inspector raised a number of questions, which were communicated to the licensee in Reference 19. These questions were all answered, to the ONR specialist's satisfaction, in Reference 20.

41. Accordingly, the ONR C&I specialist concluded (Reference 21) that he was content that the safety implications of the modification (i.e. as described in Reference 4) had been adequately considered. Accordingly, the ONR C&I inspector recommended (Reference 21) that ONR grant approval via the issue of Licence Instrument 547.

42. However, one further matter was raised ONR C&I i.e. whether the changes to be made in Reference 4 could degrade the ability of the PPS to provide HVAC isolation. This question was satisfactorily answered by the licensee in Reference 24 where it was stated that implementation of Reference 4 will not affect the ability of the PPS to provide an HVAC isolation, as the same isolation signal is also generated on 'High MCR Smoke' (for which the associated detectors are not affected by Reference 4). Additionally, if the hardware modifications of Reference 4 were to degrade and fail, then the ability of the PPS to initiate an HVAC isolation remains i.e. the PPS is still monitoring CO_2 levels (although will no longer indicate genuine CO_2 levels). The C&I specialist assessors' review was subsequently subject to peer review by the E, C&I Professional Lead who raised two further queries. The Professional Lead queried the impact of the modification on any existing safety cases and Station Operating Instructions and potential maintenance and testing implications for the primary protection system. A response to both of these queries was subsequently provided by the C&I specialist inspector to the satisfaction of the Professional Lead (Reference 26).

4 MATTERS ARISING FROM ONR'S WORK

4.1 MATTERS ARISING

43. All matters arising from ONR's assessment of References 3 and 4 have been discussed in detail with the licensee (References 13, 14, 19 and 20) and have been fully resolved to my satisfaction and that of the ONR specialist C&I inspector. Accordingly, there are now no unresolved matters arising from my assessment.

4.2 OTHER GOVERNMENT AGENCIES

44. I have consulted both the Environment Agency (EA) and ONR Civil Nuclear Security (ONR-CNS) to confirm that they have no objections to the issue by ONR of Licence Instrument 547 (Approval), permitting the licensee to implement EC 334574 (Reference 3) and hence remove all references in the SZB Tech Specs to the now redundant CO_2 monitors. Both EA (Reference 22) and ONR-CNS (Reference 23) have confirmed that they have no objection to the issue of LI 547 by ONR.

45. I consider that no additional Government Agencies are relevant stakeholders in the issue of the requested permission to the licensee.

5 CONCLUSIONS

46. This report presents the findings of an ONR assessment of References 3 and 4 and of supporting information provided by the licensee to answer questions raised on these two safety cases.

47. To conclude, I am broadly satisfied with the claims, arguments and evidence presented within Reference 3 and Reference 4 and I have received advice from ONR specialist inspectors that these constitute valid and acceptable safety cases. I am satisfied that the totality of the safety submissions, as presented by the licensee, comply with the ALARP principle and that the licensee's safety submissions meet the guidance provided by the ONR SAPs.

48. I am also content that the licensee's two safety submissions have broadly complied with the guidance provided by the relevant ONR SAPs (see Section 3.1).

6 RECOMMENDATIONS

49. I recommend that permission should be granted to the licensee, via the issue of Licence Instrument No. 547 (Approval), to make the required changes to the Sizewell B Technical Specifications to delete reference to the now redundant carbon dioxide monitors.

50. In addition, I recommend that Approval No. 4 (dated 24th April 2002) should be modified to the extent necessary to effect Approval No. 547.

7 REFERENCES

1. NSL SZB 50802R – "Request for Approval Under Licence Condition 23(5) for an Amendment to Technical Specifications, Safety Limits and Nuclear Safety Requirements, Section 2.3.3, 'Instrumentation' and Table NSR 3.2-1 in Particular," 9/6/2014 (TRIM 2014/235112)
2. E-mail – "SZB Redundant CO_2 Monitors Licence Instrument," 3/3/2015 (TRIM 2015/0080849)
3. EC 334574 – "Removal of Redundant CO_2 Monitoring Panels from Technical Specifications," Revision 0000, Version 01 (TRIM 2014/235112)
4. EC 335558 – "Disabling and Disconnection of Redundant CO_2 Monitors from PPS and HICS," Version 000 (TRIM 2015/0091710)
5. SZB/QP/GK/334574/001 – Quality Plan - "Removal of Redundant CO_2 Monitoring Panels from Technical Specifications," (TRIM 2015/0083757)
6. *ONR HOW2 Guide - Purpose and Scope of Permissioning - NS-PER-GD-014 Revision 4*. July 2014. http://www.onr.org.uk/operational/assessment/index.htm
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8. "Validation of Computer Codes and Calculation Methods," NS-TAST-GD-042, Revision 2. ONR. June 2013 http://www.onr.org.uk/operational/tech_asst_guides/index.htm
9. EH40/2005 – "Workplace Exposure Limits", HSE Publication (Last Amended October 2007), http://www.hse.gov.uk/pubns/books/eh40.htm
10. E-mail – "Re EC 335558 – Disable and Disconnect Redundant CO_2 Monitors from PPS and HICS," 4/3/2015 (TRIM 2015/0083804)
11. Milestone Full INSA Approval Statement – "Removal of Redundant CO_2 Monitoring Panels from Technical Specifications," 7/5/2014 (TRIM 2014/235112)
12. EdF Energy Nuclear Generation Ltd Nuclear Safety Committees Minutes of Meeting Held at Sizewell B on 14th and 15th May 2014 (TRIM 2014/235112)
13. E-mail – "Questions with Respect EC 334574," 29/1/2015 (TRIM 2015/35029)
14. E-mail – "ONR Questions and Answers with Respect to EC 334574," 2/3/2015 (TRIM 2015/0080179)
15. "The Control of Substances Hazardous to Health Regulations 2002," Statutory Instrument 2002 No. 2677
16. E-mail – "Re EC 334574 – "Removal of Redundant CO_2 Monitoring Panels from Tech Specs," 3/3/2015 (TRIM 2015/0082208)
17. E-mail – "Re SZB Safety Case for Removal of CO_2 Detector Panels for HVAC," 29/1/2015 (TRIM 2015/0047163)
18. E-mail – "Re SZB Safety Case for Removal of CO2 Detector Panels for HVAC," 29/1/2105 (TRIM 2015/0047251)
19. E-mail – "Questions Regarding EC 335558," 10/3/2015 (TRIM 2015/90655)
20. E-mail – "Questions Relating to EC 335558," 11/3/2015 (TRIM 2015/0096399)
21. E-mail – "C&I Assessment of EC 335558," 16/3/2015 (TRIM 2015/0109339
22. E-mail – "Re Removal of Redundant CO_2 Monitors – SZB," 6/3/2015 (TRIM 2015/0088162)

23. E-mail – “Re ONR-CNS Consideration of ONR Permissioning Decision Required Please,” 29/1/2015 (TRIM 2015/35906)

24. E-mail – “Re: EC 335558 – Disable and Disconnect Redundant CO_2 Monitors from PPS and HICS,” 2/4/2015 (TRIM 2015/0129999)

25. ONR HOW2 Guide – Guidance on production of reports - NS-TAST-GD-084 Revision 8 - (AST/003) TRIM Folder 1.1.3.566. (2015/111520)

26. E-mail – ‘Operating Reactors - SZB - C&I assessment of EC 335558 including C&I Professional Lead queries and response to those queries’ 05/05/2015 (2015/165588).

27. Sizewell B CO2 monitoring removal - ONR Assessment Note - 07 May 2015 - TRIM Folder 4.4.1.2691. (2015/168833)

28. Operating Reactors - SZB - PAR SZB Removal of CO2 Monitors - TRIM Folder 4.4.1.2691. (2015/110618) – Revision 0 – April 2015.