BMS/AST/003
ND Division 2 Assessment Report No 069/2009
Open Government Status: Fully Open

HEALTH & SAFETY EXECUTIVE
NUCLEAR DIRECTORATE
ASSESSMENT REPORT

Sites:	**Hinkley Point B**
Project:	Hinkley Point B Gas Bypass Contamination event (16th July 2009)
IPG:	**N/A**
Specialism:	Radiation Protection
Title:	**Hinkley Point B Gas Bypass Contamination event (16th July 2009)- Radiological Protection Advice**
Licence Number:	62A
Licence Condition Number:	10, 12, 24, 26, 34
Relevant Regulations:	HSWA , IRRs 99 (reg 8)
COIN Field Service Order	N/A
IIS Assessment Rating:	
ND Issues Database Record:	N/A

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File Note

Hinkley Point B Gas Bypass Contamination event (16th July 2009) - Radiological Protection Advice

Background

1. On July 16th 2009 during maintenance work of the gas bypass plant on one of the Hinkley Point B reactors a number of workers (BE staff and contractors) were involved in an internal contamination incident. A release of contaminated dust from the gas circulators resulted in an area of the gas bypass plant becoming contaminated and a number of individuals experiencing low levels of internal contamination.

2. Dose assessments for the individuals involved have been completed; these indicate that the highest internal dose is of the order of 60 microsieverts. The maximum external doses were 20-30 microSieverts.

3. Based on information gained during our investigation the release of contaminated graphite from the circuit occurred as a result of the miscommunication between 2 individuals that resulted in an individual changing the configuration of the plant ventilation in the control room. The control room is remote from the gas bypass plant. A further unusual circumstance is that although all personnel in that area of plant evacuated the immediate vicinity they did not leave the shared air space for an extended period (~45 minutes). This was because of a concern regarding the spreading of contamination out of the bypass plant area. Spread of contamination is an important issue however; this is of lower priority than the protection of personnel. It would have been reasonable to congregate immediately outside the exit door, thus reducing the spread of contamination but protecting the personnel.

4. ND when making decisions requiring enforcement at Nuclear Licensed sites follows guidance in HSC's Enforcement Policy Statement and HSE's guidance provided by the HSE Enforcement Management Model (EMM). This is used to make an initial assessment of the health and safety risks posed by the particular activity and determines the actual risk (where the duty holder is). This is then compared to the benchmark risk, which is the risk accepted by law or guidance as tolerable, the level of risk remaining once the actions required of the duty holder by the relevant standards, enforceable by law, are met (where the duty holder should be). The difference between where the duty holder is and where the duty holder should be is the **risk gap.** Further guidance on making decisions regarding enforcement where a health effect is involved, in this case specifically as a result of exposure to ionising radiation, is provided in the FOD Operation Circular (OC) 130/11. ND was fully consulted on the contents of this OC and thus follows its guidance.

5. The OC considers that any whole body exposure to ionising radiations is assumed to result in an increase in the risk of an individual suffering from a radiation induced disease in direct proportion to the dose (these are referred to as Stochastic effects and the dose response relationship is known as the linear no threshold

model). When considering stochastic effects the primary concern is the induction of fatal cancers, which are considered to be a "serious health effect" and equivalent to serious personal injury under the terms of the EMM. Any whole body radiation dose therefore increases the chance that an individual might suffer from a radiation induced fatal cancer and the greater the dose the greater the risk of occurrence.

6. The Ionising Radiations Regulations 1999 (IRR99) require that stochastic effects of radiation doses are restricted so far as is reasonably practicable and deterministic effects prevented by compliance with dose limits. The IRR99 and associated Approved Code of Practice & Guidance (L121) form the defined minimum standard for health and safety risk for exposure to ionising radiations. The overarching requirement of IRR99 to restrict exposures so far as is reasonably practicable (SFAIRP) results in a level of exposure which is as low as reasonably practicable (ALARP) and is the benchmark in terms of the EMM. Any increased actual or potential dose above the ALARP level could increase the likelihood of a serious health effect (radiation induced disease such as fatal cancer). The extent to which the ALARP level either has or could have been exceeded should form the basis of enforcement decisions.

7. The EMM uses categories of likelihood of harm to inform the decision making process which is relatively simple and straightforward to apply in cases of actual or potential physical injury. In the case of ionising radiation, the ALARP consideration requires a slightly different approach based upon the excessive exposure above the ALARP level. In addition the use of the descriptors "nil" and "probable" present great difficulties when used with the linear no threshold model of radiation dose and effect. The following descriptors are therefore used in respect of stochastic effects for "likelihood of harm" can be seen below.
    - Exposures or potential exposures at or below the determined ALARP Level the likelihood should be regarded as Negligible,
    - Exposures or potential exposures just greater than the determined ALARP level, the likelihood should be regarded as Remote
    - Exposures or potential exposures much greater than the determined ALARP level the likelihood should be regarded as Possible.
    - Exposures or potential exposures very much greater than the determined ALARP level the likelihood should be regarded as Significant.

   For cases where stochastic effects are being considered then the consequence of exposure should be regarded as a potentially "Serious Health Effect" this being equivalent to "Serious Personal Injury" under the terms of the EMM. This relationship has been established in OC130/5 (EMM – General Guidance on Health Effects.).

Determination of ALARP Benchmark.

8. A number of factors need to be taken into account when determining the ALARP benchmark. These include the legal limits (IRRs 99 Reg 11 schedule 4) and the legal responsibility to keep doses ALARP (IRRs 99 Reg 8). The type of work carried out in the controlled area and the controls in operation. The type of radiation exposure involved (external/internal, stochastic/deterministic, whole body/extremity etc.). Dose constraints applied to this work, the practicability of

dose reduction techniques applicable to this particular case. Industry standards and guidance available to the Licensee for this type of work practice may also be appropriate.

9. Thus the following were taking into consideration:

- The work to be carried was originally to be undertaken with the system isolated thus no contamination was expected. When this technique became unavailable the Licensee provided ventilation (via the gas circulators) as an engineered measure to prevent the spread of contamination. The Licensee did not expect loose contamination to be present, however, as a precaution they provided RPE for some individuals very close to the workface as an ALARP measure.

- The internal contamination occurred as the result of an unplanned incident and unplanned exposure route. The exposure was acute in nature and the release could have been larger than the 20 MBq estimated by the Licensee. Also for that release doses to individuals could have been larger.

- In principle internal contamination is to be avoided because of the "committed" nature of the dose. That is, depending on the radionuclide involved, an intake will result in the individual's tissues continuing to be irradiated by the incorporated material, potentially many years after the incident. However, the risk of ill-health as a result of an intake is reflected in the assessed dose, (small dose = low risk), taking account of the type of radiation emitted, the radioactive half-life and the biological half-life in the body of that particular radionuclide.

- It is custom and practice in the nuclear industry to use RPE (which effectively reduce intakes to nil), ventilated engineered enclosures, barriers, prescribed undressing and monitoring procedures where a possibility of airborne/surface contamination is extant. Intrusive work of the nature where significant levels of airborne contamination could be generated would attract the use of significant engineered controls and high protection factor RPE as a precaution.

All these factors taken together, leads me to the opinion that the ALARP benchmark in this case should be set at 0 mSv.

<u>Determination of Risk Gap</u>

10. The OC then requires the specialist assessor to advise on the degree to which a practice had exceeded the requirements of ALARP and apply the risk matrix in the OC. Within this consideration the assessor should at least consider the factors below (not an exhaustive list);
    - The expected ALARP dose for the practice,
    - The degree to which the expected ALARP dose has or may have been exceeded,
    - The degree of reasonable practicability expected,
    - Adequacy & evidence of planning,
    - The dose constraint used in planning (if relevant), and

- Any unforeseen factors.

11. Also when assessing the extent to which the actual or potential dose exceeds ALARP, consideration should be given to the magnitude of the benchmark. Examples of doses greater than the ALARP level which might be considered to lead to negligible, remote, possible or significant likelihoods are given in the OC. Duty holder factors should be taken into account, in cases where there are multiple then enforcement action should be considered more likely (for the same degree of ALARP failure) than in a case of a single failure of an otherwise compliant employer.

12. I have considered the following factors to assess the risk gap on the particular case

- The ALARP dose for this work is 0 mSv; this benchmark was exceeded by a number of individuals. However, the actual total dose received by these individuals, despite the extended exposure, was low, maximum [redacted] microSieverts. This, compared to the annual dose limit for employees of 20 milliSieverts, is low.
- While the ALARP dose has been exceeded by <1 mSv, because the release of contamination was unplanned and unexpected by the Licensee they had not taken additional engineered precautions such as providing a temporary enclosure round the workface, the potential release could have been more significant. It would have been reasonably practical to provide a temporary enclosure and provide a portable alarming air sampler adjacent to the work area.
- It would have been very reasonable for all workers in the area to evacuate to a position immediately outside this area and wait for assistance, rather than stay in the same effective 'room' for and extended period of time.
- There was evidence of planning and the use of work control arrangements, however, the Licensee failed to correctly identify the extent of the hazard at this particular workface. Open circuit working, even whilst ventilated, will always carry a risk of release of contamination. Whilst this particular circumstance of miscommunication that led to the 'puff of activity' been driven out of the circuit via the gas bypass plant was not reasonably foreseeable, the potential for release should always be considered. When breaking containment of a grossly contaminated circuit it is reasonably foreseeable that contamination could escape. This should result in consideration of either engineering and/or administrative arrangements to prevent egress in conjunction with mitigation measures such as RPE, enclosures and alarming sir samplers.
- There was strong evidence of poor communications and control of the work in this particular job.

All these factors taken together lead me to the opinion that the degree to which the ALARP benchmark has been exceeded is possible and the risk gap in this particular case is substantial.

Conclusions

1. A number of individuals received a small but measurable internal contamination when this could easily have been prevented.
2. There was clearly a potential for the individuals to have received a larger dose as the release was unexpected and uncontrolled and could easily been much larger.
3. Disappointingly the Licensees initial response to the incident appeared to be very focussed on protection of plant areas from spread of contamination to the detriment of individual's dose uptake.
4. The ALARP benchmark in this case should be set at **0 mSv**.
5. The degree to which this particular event has exceeded the requirements of ALARP (the benchmark) is considered **remote**.
6. This risk gap in this particular case is **substantial**.

Recommendations

1. Based on the conclusions above I recommend that the site inspector considers enforcement action. In this circumstance the initial enforcement expectation is a formal letter raising our findings, requiring the Licensee to address the deficiencies in their arrangements to an agreed program. This in my opinion this would be appropriate on this occasion.

References

1. HSC Enforcement Policy Statement.
2. HSE Enforcement Management Model (EMM) September 2002.
3. OC130/05 HSE Enforcement Management Model (EMM) – General Guidance on Application to Health Risks.
4. OC130/11 HSE Enforcement Management Model (EMM) – Application to Ionising Radiations.
5. VR HPB 12/2009. [redacted]. 28 July 2009. Trim ref. 2009/291790.
6. VR HPB 13/2009. [redacted]. 28 August 2009. Trim ref. 2009/339406.
7. NII Letter HPB 71668R. [redacted]. 13 August 2009. Trim ref. 2009/313677.
8. BE Letter HPB 51100N. [redacted]. 26 August 2009. Trim ref. 2009/337795.
9. Case conference notes TRIM ref 2009/361803