Radon impact assessment - Supplementary document to Appendix B

1 Introduction

There is a potential for some activities to give rise to materials containing radionuclides. In particular Lancashire County Council, in their scoping response, specifically request that releases of radon be assessed to determine exposure to the general public and significance with respect to dose limits.

In this case it is considered that there are two primary sources of radon 222 within the activities intended:

- Radon 222 contained within the natural gas produced during the flow testing phases (Phases 5 and 6) of the operations
- Radon 222 from the decay of radium 226 in produced waters

The natural gas produced will be disposed of in the flare. Produced waters will be processed in phase separation equipment with the any gas removed being disposed of in the flares.

The release of radon 222 from site operations is therefore considered to be an emission to air via the flares.

2 Screening assessment methodology

The Environment Agency and others have developed and published principles and guidance for the assessment of public radionuclide doses. A staged approach to the assessment of critical group doses for waste disposal authorisation purposes is provided in guidance[1,2] with three stages of assessment.

The first stage involves a simple and cautious assessment of the critical group dose rate using default values for assessment and model receptor groups. If the resulting effective dose rate is less than 20 µSv/y then no further assessment would be warranted for the purpose of authorising the discharge of radioactive waste to the environment.

The second and third stages involve increasing refinement of the parameters describing the transport of radionuclides and the specific location and composition of critical groups.

The screening dose rate of 20 µSv/y may be compared with the dose rate for the general public (Ionising Radiation Regulations, 2017) of 1000 µSv/y.

3 Radon releases

Release of radon have been determined based on full load flare activity and an estimate of the volume of produced water.

The amount of natural gas disposal during the initial and extended flow testing phases is assumed to be equivalent to full time, full load operation of the flares as summarised in Table 1.

Table 1 Natural gas flared

Phase		Initial flow test	Extended flow test
		5	6
Flare capacity	MMscfd	6.5	4.4
	Nm^3/s	2.0	1.4
Duration of phase	days	60	90
Gas disposal	m^3	1,0368,000	1,0876,400

It is estimated that around 14310 m^3 of water will be produced[3].

The specific activity concentration of Radon 222 within the natural gas and produced water is assumed at 200 Bq/m^3 and 90 Bq/l respectively based on values at similar opertaions[29].

The overall release to air is estimated at 5.54 GBq as summarised in Table 2. This is assumed to be the annual release rate, although the activities considered will only operate for part of the year.

Table 2 Radon release rate

Source	Natural gas	Produced water
	5	6
Disposal volume	21254400 m^3	14310 m^3
Specific activity concentration	200 Bq/m^3	90 Bq/l
Release to air	4.251 GBq	1.288 GBq
	5.539 GBq	

4 Assessment of dose

The guidance provided by the Environment Agency for an initial radiological assessment methodology was used to determine the significance of the releases. The critical group was considered to be a local family living within 100 m of the site and consuming food produced at 500 m from the site. The family is considered to be exposed to radiation from the flare plume via three routes:

Inhalation of the plume
External radiation from the plume and deposition to ground
Consumption of food containing deposited radionuclides

The dose per unit release (DPUR) for radon 222 for this group was determined from guidance[1] as summarised in Table 3.

Table 3 Determination of DPUR for radon 222

Route	DPUR (µSv/y per Bq/y)
Terrestrial food consumption	0
External radiation	4.5×10^{-16}
Inhalation	2.4×10^{-10}
Total	2.4×10^{-10} (Infant)

It is assumed for the Stage 1 assessment that releases from the flare occur at ground level with a scaling factor for dispersion of 1.

The dose rate is calculated as in Table 4.

Table 4 Determination of dose

Radionuclide	Discharge (Bq/y)	Total DPUR (µSv/y per Bq/y)	Dose (µSv/y)
Radon 222	5.54×10^{9}	2.4×10^{-10}	1.33

The total dose experienced by the worst age group (Infant) is 1.3 µSv/y, which is well below the screening criteria of 20 µSv/y.

It should be noted that this assessment is based on a flare release at ground level. In practice the flare height is between 7.9 m and 12.6 m which, if considered, would provide a reduction in the estimated dose of around 75%.

5 Conclusion

The estimated Radon 222 dose of 1.3 µSv/y resulting from operational activities is considered to be a worst case assessment and is well below both the Environment Agency screening criteria of 20 µSv/y for waste disposal authorisations and the statutory general dose rate for members of the public of 1000 µSv/y. It is considered that this dose is not significant with respect to human health.

6 References

1. Environment Agency, Initial radiological assessment Part 1 – user report, Report SC 030162/SR1, May 2006.

2. Environment Agency, Initial radiological assessment Part 2 – methods and input data, Report SC 030162/SR2, May 2006.

3. Private communication, email E Walker (Zetland Group) to N Ford (SOCOTEC), dated19 September 2018.

4. Arup, Cuadrilla Bowland Limited, Temporary shale gas exploration, Preston New Road, Environmental Statement, PNR_ES_Volume 1, May 2014.

END OF REPORT