



Urenco UK Limited

# Capenhurst Radiation (Emergency Preparedness and Public Information) Regulations 2019

## Regulation 7 Submission

### Consequence Report

	Author	Checker	Reviewer	Approver
Name:	Consultant	Emergency Planning Manager	Site Senior RPA	Head of Compliance
Sign:	Signed off 14/10/2019	Signed off 14/10/2019	Signed off 14/10/2019	Signed off 14/10/2019
Date:				

This is the consequence report for the Capenhurst Site as required by the Radiation (Emergency Preparedness and Public Information) Regulations 2019 (REPPiR19). Relevant sections of the regulations and support schedules are given in boxes for context.

Schedule 4, Part 1.

1. The following factual information must be provided in the operator's consequences report—

- (a) the name and address of the operator;
- (b) the postal address of the premises where the radioactive substance will be processed, manufactured, used or stored, or where the facilities for processing, manufacture, use or storage exist;
- (c) the date on which it is anticipated that the work with ionising radiation will commence or, if it has already commenced, a statement to that effect.

There are three operators on the site:

(1) Urenco UK Limited (2) Urenco Nuclear Stewardship Limited; (3) Urenco ChemPlants Limited.

Address:

Urenco UK Limited  
Capenhurst,  
Cheshire,  
CH1 6ER,  
UK

The address above is also the postal address of the premises where the radioactive substance will be processed, manufactured, used or stored, or where the facilities for processing, manufacture, use or storage exist.

Work with ionising radiation has already commenced on the site.

## Schedule 4, Part 2.

2. The operator must include the following recommendations in the consequences report—

- (a) the proposed minimum geographical extent, if any; and
- (b) the minimum distances to which urgent protective action may need to be taken, marking against each distance the timescale for implementation of the relevant action.

From the radiological point of view, Urenco UK recommends that a Detailed Emergency Plan Zone should at least cover the area within 400 m of the areas where cylinders of uranium hexafluoride are stored or processed. This distance includes the area within which the avertable radiation dose exceeds the lower Emergency Reference Level (ERL) for shelter for the faults investigated. Up to this point, the benefits of the protective actions are thought to exceed the detriments. An indicative plot of the 400 m contour is shown in Figure 1 as the inner line. This is compared with the current DEPZ which is the 1 km radius circle.

Protective actions are recommended to avert dose. Shelter reduces dose from the moment it is implemented to the moment the plume passes that point. Therefore it should be implemented as soon as possible and stay in place at least until the release has stopped and the plume has passed that location.

People may be affected by the non-radiological effects of the release further downwind than the distance at which the lower ERL of shelter is just achieved.

## Schedule 4, Part 2.

3. Where a minimum geographical extent is recommended under paragraph 2, the operator must also include within the consequences report—

- (a) the recommended urgent protective action to be taken within that zone, if any, together with timescales for the implementation of that action; and
- (b) details of the environmental pathways at risk, in order to support the determination of food and water restrictions in the event of a radiation emergency.

Inhalation is the dose pathway of initial concern. Thereafter the consumption of these compounds, particularly uranium, in contaminated foodstuffs should be

minimised. Thus there is an urgent need to give advice to shelter to those downwind of an atmospheric release or potential atmospheric release and a need to give advice not to eat fruit and vegetables harvested within the contaminated area since the release and to prevent locally produced milk being drunk from about a day after the event.

Rain can greatly enhance deposition and, in particular, showers during plume transit can result in significant deposition hot-spots where it rains through the plume. This may result in the need to control food production and consumption further from the site.

In dry weather, the levels of uranium in fresh vegetables and fruit could exceed the control values for radiological contamination out to 2 km – 3 km in average weather for a release towards the upper range of credible for a duration of two to eight hours. In adverse weather the effects could be further downwind.

The release of radionuclides and harmful chemicals to the water courses is also possible, particularly if water curtains are used in an attempt to reduce atmospheric dispersion, and post-accident surveying and area restrictions should consider this.

In the longer term there may be a need to change farming and domestic food growing on the effected land and to restrict access and the types of activity in some affected areas until remediation is completed.

## Schedule 4, Part 3.

## Rationale

4. The operator must set out the rationale supporting each recommendation made in the consequences report.

5. In particular, the operator must set out—

- (a) the rationale for its recommendation on the minimum distances for which urgent protective action may need to be taken; and
- (b) where the operator and local authority have agreed that no off-site planning is required, and therefore no emergency planning is recommended, the rationale for that agreement.

All of the faults that could affect the public off-site (except criticality events, which are a special case) involve the release of uranium hexafluoride (UF<sub>6</sub>) which poses both a radiological risk and a non-radiological risk.

A review of the site safety cases has identified a range of faults that result in the release of UF<sub>6</sub>. These releases can be prompt in those cases where the containment fails; for example

- cylinders being crushed by falling cranes or buildings;
- cylinders failing under excessive internal pressure which may result from operator errors or plant control failures leading to the heating of overfilled containers or the overheating of cylinders.

Releases can also continue for up to about eight hours where the initiating event exposes the UF<sub>6</sub> to the atmosphere (breached or dropped cylinders) and then chemical and physical process mobilise the radioactive material or produce chemotoxic gases or fine suspensions.

The site safety cases consider the events that might befall a cylinder, or set of cylinders, and estimate the quantities that might be released initially and over the following period of time. From this, the radiological and non-radiological consequences are estimated and the distances downwind that certain thresholds are exceeded estimated.

The largest potential releases result from faults that either move cylinders of feed within the process breaching their containment or where a building collapses and disrupts cylinders within the process and the systems around them. Safety case “best estimate” dose estimates are made on the basis of two cylinders being affected at once.

The best estimate calculations suggest shelter instructions, based on the lower ERL of 3 mSv avertable dose (7.5 mSv projected dose), would be between 120 m and 180 m downwind, depending on the duration of the release, but could be 400 m in adverse weather conditions. This assumes that shelter averts 40% of dose compared to being outside and that it is implemented immediately. Any delay in implementing shelter will reduce its effectiveness and bring the boundary inwards.

The radiation doses quoted are adult inhalation dose. It has been shown that the adult dose is the largest of the three age groups considered and that inhalation dose is significant higher than cloud dose and short-term ground dose.

Were radiological impacts the only concern, the advice might be that a DEPZ of 400 m from the locations where UF<sub>6</sub> is stored, transported or processed, in which there was a plan to urgently advice shelter would be sufficient but see annex on non-radiological impacts.

In the event of a criticality, the local authority off-site plan should concentrate on evacuating the area close to the site (in case there are subsequent criticalities) and identifying those who may have been exposed. Exposed individuals will require dose assessment and counselling.

It should be noted that the consequences described above are for a particular event sequence. It is likely that, if the emergency scheme was initiated by Urenco, it would be in response to an event with lower consequences.

An outline planning zone of 5 km, as given in Schedule 5 of REPPiR19 for category 3 sites, is appropriate for the Capenhurst site.

### **Annex – Non-radiological harm**

Three levels of potential harm are considered for non-radiological impacts.

1. Discomfort level – This is the onset of discomfort to individuals, without the potential for long term harm;
2. Dangerous Dose – This is defined as a dose of a toxic gas, or heat or explosion overpressure which gives all of the following effects;
  - a. Severe distress to almost everyone;
  - b. A substantial fraction of the population requires medical attention;
  - c. Some people are seriously injured requiring prolonged treatment;
  - d. Any highly susceptible people might be killed.
3. Significant Likelihood of Death (SLOD) – this is the level of toxicity that relates to the mortality of 50% of the exposed population.

For HF the following limits have been used:

Uncomfortable	498 mg/m <sup>3</sup> .min
Dangerous	10000 mg/m <sup>3</sup> .min
SLOD	17466 mg/m <sup>3</sup> .min

And for Uranic compounds:

Uncomfortable	8.3 mg
Dangerous	40 mg
SLOD	230 mg

Contour	Downwind distance in km		
	D(5) 2 hr	D(5) 8 hr	F(2) 2 hr
HF SLOD	0.12	0.18	0.4
HF Danger	0.16	0.4	0.4
HF Uncomfortable	1	2	3
U SLOD	0.2	0.4	0.6
U Dangerous Dose	0.6	0.8	2
U Uncomfortable	2	3	4

Table: Downwind distances (km) for chemo-toxic effects.

It can be seen from the table of results above that uranium intakes are estimated to result in a significant likelihood of death out to a downwind distance of 200 m – 400 m in average weather conditions for a release that terminates in two hours or eight hours respectively. It is dangerous over 600 m – 800 m and potentially uncomfortable over 2 km – 3 km. On the basis of this information, 800 m downwind of potential accident areas would be a sensible range for a plan to implement urgent sheltering to reduce serious non-radiological impacts. An indicative plot of this contour is shown in Figure 1 as the outer shape.

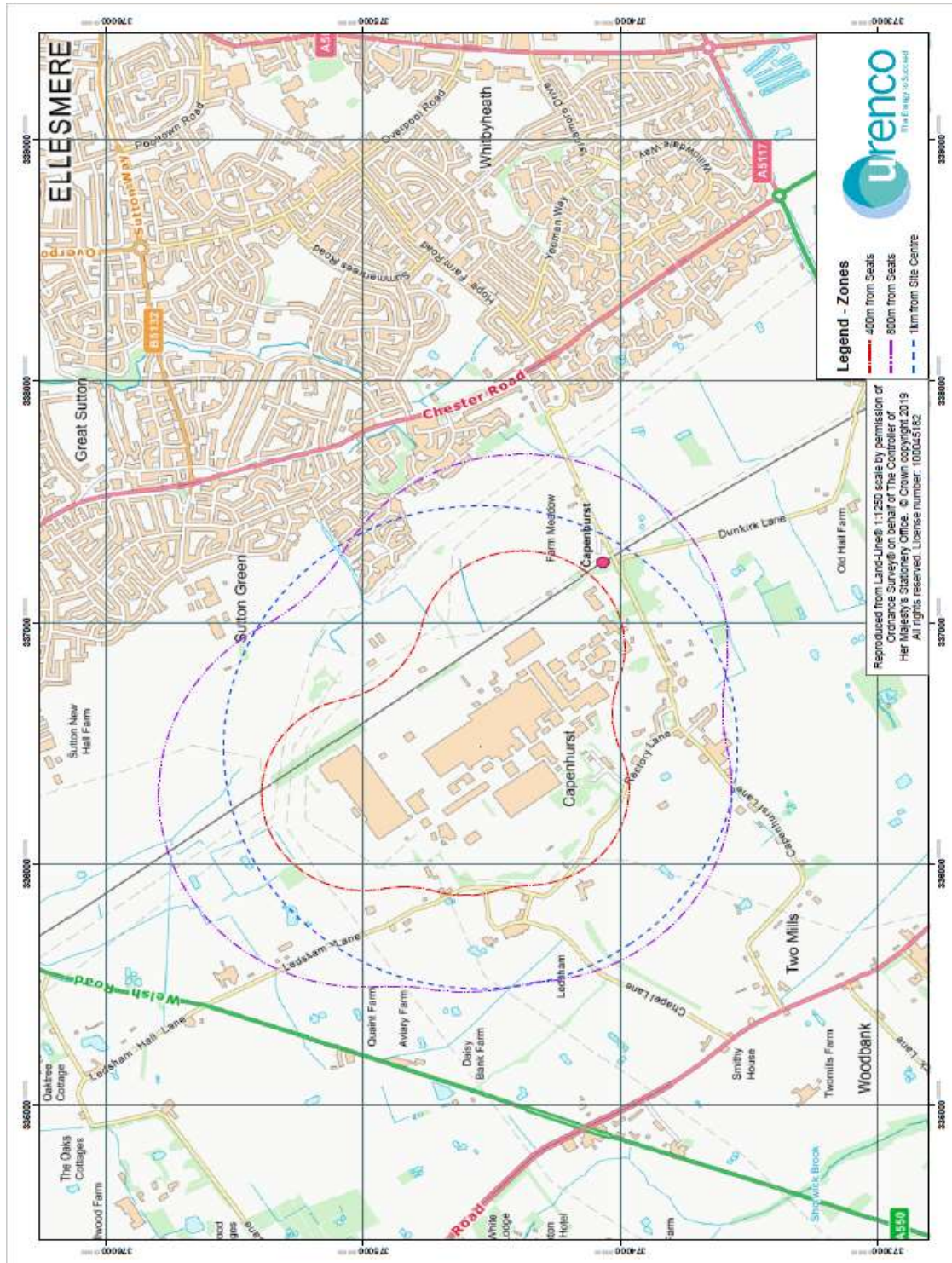
## Discussion

The 400 m contour is in a rural setting but, if it were adopted as the basis of the DEPZ the local authority would have to make some decisions about where to draw the line with respect to a number of houses just outside the zone.

The 800 m contour comes close to housing to the north and overlaps housing to the east. Again the local authority would have to make some choices about the DEPZ.



Figure 1 Current and proposed DEPZ



Map shows: Previous DEPZ of 1km Radius Around Site, Proposed DEPZ 800m contour from source of release and 400m radiological contour.