

Scottish CND News**NAVY MANUALS COMPARE SUBMARINE ACCIDENT WITH CHERNOBYL**

The following is an extract from "Hazards of a nuclear accident" produced by the Department of Nuclear Science and Technology at the old Royal Navy College Greenwich in 1992. The contents were published on the front page of the Scotsman newspaper on 19th August 1993.

This is a training manual used to instruct Navy officers. It describes three possible nuclear accidents on a submarine. The most serious, a Primary Containment Failure Accident is called a Benchmark 6 (BR6) accident. It goes on to say that Chernobyl was also a BR6. Figures are given to show the effect of a BR6 accident based on Chernobyl. These show that Potassium Iodate Tablets should be issued 100 kms from the scene and evacuation should be carried out up to 10 kms from the accident.

1. Benchmark Releases

The amount of radioactivity released in a reactor accident depends on the core inventory at the time of the accident and

on the particular accident sequence. The core inventory will depend on reactor power rating and the detailed operating history. The benchmark releases are based on a Standard Core History inventory.

The fraction of activity released will depend on the extent of fuel melt, the volatility of the various radionuclides and the integrity of the containment systems (primary and secondary). The reactor compartment forms the primary containment and is designed to withstand the pressure surges associated with the accident. It is designed to be virtually leak-tight and its hermetic properties are regularly tested. Therefore, provided the containment remains intact, the release of fission products from the RC to the rest of the vessel should be very small indeed. Moreover, if secondary containment is secured, the release to the environment will be further reduced. In the most likely event, the accident will give rise to a slow seepage of mainly inert gases (Kr, Xe) with perhaps a trace of the more volatile radionuclides such as I and Cs. This scenario forms the basis for the benchmark release BRO.

For planning purposes it would be inappropriate to assume such a small release. The primary containment boundary is penetrated at various locations (eg to allow cabling to reach reactor instrumentation), and these penetrations represent possible leak sites. Thus, for planning purposes, it is assumed that 1% of all fission products in the RC leak out over 24 hours, and that a further 10% of those are released to the atmosphere. This scenario forms the basis of benchmark release BR3.

On the other hand, it is just conceivable that for some reason both primary and secondary containment fail, or are by-passed, (eg penetration of the hull). In this extremely unlikely event it is possible that the entire contents of the RC could be released in a very short time (minutes). This scenario, the so-called Primary Containment Failure Accident, forms the basis for the "worst case" benchmark release, BR6.

BR6.

Table I summarises the release fractions and release durations assumed for each of the three benchmark releases. Also, in order to put the releases into some perspective. Figure 2 illustrates a "Richter Scale" of nuclear accidents. Note that the scale is logarithmic (ie an accident on scale 4 releases ten times as much activity as a scale 3 accident). The Windscale, Three Mile Island and Chemobyl accidents are represented. The BRO, BR3 and BR6 benchmark releases would be at 0, 3 and 6 on the scale, respectively.

2. Consequences of the Benchmark Releases

Figure 2 shows the whole body dose profile (dose versus distance from the source) for each of the three benchmark releases, in "average" weather. The whole body dose includes cloudshine, inhalation (50 year committed EDE) and groundshine (dose accrued in first 24 hours only). The horizontal lines on the graph are the 1 mSv (annual background) and 100 mSv (evacuation EAGL) doses. From the graph it is clear that the EAGL is NOT exceeded beyond 500 metres in the case of BRO and BR3. However, in the case of BR6, the EAGL for evacuation IS exceeded, to a distance of some 10 km.

Figure 3 shows the dose to the thyroid as a function of distance from the source. In this case, 95 per cent of the dose is from inhalation of radioiodine. The EAGL for distributing PITs is 50 mSv. Comparison of the dose profiles with this limit shows that for BRO there is no exceedance beyond 100 metres. In the case of BR3, the EAGL IS exceeded to a distance of approximately 1 km. For the BR6 release the EAGL is exceeded beyond 100 km. The dose profiles obtained from the BR3 release (the "planning" accident) are shown in figures 4 and 5 with finer resolution. In this case, the profiles are shown for "average" weather (that is, stability category D, wind-speed 4m/s) and for "worst-case" weather (that is, stability category F, wind-speed 1m/s). At any distance, the difference between average and worst case weather is about a factor of 6 - 10. In Figure 4 (whole body dose), the 100 mSv EAGL is not exceeded beyond 100 metres in average weather, but IS exceeded out to a distance of some 500 metres in the worst case.

The EAGL is NOT exceeded beyond the site boundary at 550 metres. In figure 5, the thyroid dose exceeds the 50 mSv EAGL to a distance of 300 metres in average weather, increasing to 1.5 km in the worst case. The doses quoted above are subject to large uncertainties and should be treated with some caution. Nevertheless, they provide "ball park" figures for the extent of the hazard posed by each of the specified releases.