AN ANALYSIS OF ROYAL NAVY PUBLIC SAFETY SCHEMES

Background Information

Around this country there are civilian ports, deep water lochs and bays, shipbuilding yards and naval bases that are visited by or have some other connection with Royal Navy nuclear powered submarines.

Because these submarines are powered by nuclear reactors, special precautions need to be taken to ensure that no accident occurs whilst a submarine is at any of these places. And that if one does occur, adequate measures are in place to deal with such an event.

To this end Public Safety Schemes or Special Safety Schemes as they are otherwise known are set up by the Royal Navy. These schemes are set up in liaison with local authorities and emergency services. The primary function of these Schemes is to establish communication links between the military and civilian authorities.

There are two different types of berth in this country for nuclear powered submarines. These are:

1) X-BERTHS. These are places where nuclear powered submarines are based at all times (their operational base). There are two Royal Navy bases that have X-Berths.
i) Plymouth Royal Navy Base.
ii) The Clyde Submarine Base, Faslane.

2) Z-BERTHS. These are places that nuclear powered submarines only occassionaly visit. Places like civilian ports, where submarines visit to rest the crew, pick up supplies etc. Others are shipbuilding and refitting yards where submarines are built and rebuilt. Others are remote lochs and bays in Scotland with little or no population in the vicinity. In total, there are TWENTY-SIX Z-Berths around the coast of this country. These are:

Barrow-in-Furness
Barry
Brodick Bay
Campbeltown
Cardiff
Coulport
Devonport
Firth of Forth
Glen Mallan
Lamlash Bay
Lerwick and Shetland Isles
Liverpool
Loch Ewe
Loch Fyne
Loch Goil
Loch Striven
Portland
Portree
Portsmouth
Raasay
Rosyth
Rothesay
Southampton
Spithead
Thurso Bay
Torbay

As mentioned previously, Public Safety Schemes are set up around all X and Z Berths in this country. These schemes contain contingency plans for use in the event of an accident involving the nuclear reactor of a submarine. The Schemes describes two types of accident that may occur; discusses the chances of an accident occuring; outlines countermeasures which are to be

taken to prevent an accident; and countermeasures which are to be taken after an accident occurs in order to avoid any undue hazard to health. These countermeasures include:

1) Evacuation of all non-essential personnel from a zone of 550 metres around the accident site.

2) Distribution of potassium iodate tablets to personnel within the 550 metre zone and, if necessary, to selected groups outside this zone.

3) Control of the sale and consumption of exposed foodstuffs and arrangements to prevent the consumption of contaminated milk out to as far as nine kilometres from the scene of an accident (dependent on which Scheme you happen to read).

4) Possible evacuation of the general public from certain areas out to one or two kilometres (dependent on which Scheme you read).

However detailed these Schemes may seem, they are wholly inadequate!

Chances of a Reactor Accident

The Royal Navy describes two possible reactor accidents in their Schemes: the Maximum Design Accident and the more serious Primary Containment Failure Accident. The Maximum Design Accident, according to the Royal Navy, has a probability of occuring once in every 10,000 years of reactor operation and could possibly result in a release of 1,000 curies of Iodine-131 and 100,000 curies of other volatile and gaseous fission products. The Primary Containment Failure Accident has a probability of occuring, according to the Royal Navy, once in every one million years of reactor operation and could release up to 100,000 curies of Iodine-131 and 10,000,000 curies of other volatile and gaseous fission products.

The Royal Navy has never provided any technical or engineering explanations to justify this selection of accident scenarios or probability statistics.

As with any other complex piece of engineering, the Royal Navy nuclear reactor is far from fault free. In a recently leaked Royal Navy document it was revealed that there had been 712 incidents involving submarine nuclear reactors between 1964 and 1978. That is a rough average of ONE incident every week. Luckily, there have been no known incidents involving naval nuclear reactors which have resulted in a release of radioactivity to the atmosphere to date.

Evacuation

All Public Safety Schemes propose an evacuation of an area of 550 metres around the site of a submarine reactor accident immediately an accident occurs. This area is almost always within the strictly controlled area of a naval base or a civilian dock. Only at Devonport Naval Dockyard does the 550 metre infringe on civilian population. It is in fact a criteria for any Z- or X-Berth that no member of the general public lives within this distance and that all berths are sited as far away as possible from schools, hospitals and other public buildings. However, in some cases this is impossible to fulfill. This evacuation distance is considered to be grossly inadequate by many experts.

One of these experts is W. Jackson Davies, Ph.D, a biologist from America. He has carried out numerous studies into the possible consequences of accident involving naval nuclear reactors and nuclear weapons. These studies have used calculations reccomended by the Nuclear Regulatory Commission in America to calculate the likely spread of radioactive materials after an accident involving a 100 MegaWatt naval nuclear reactor. These studies are considered by other experts to be conservative in their assumptions, yet the results of these studies are a cause for concern. One of the major reccomendations in all of his studies is that:

> "....evacuations areas should be extended to a minimum of 5 km from the accident site for densely populated urban areas....."

Sheltering

It is highly likely that the first action to be taken if there is any risk to to the general public will be a series of announcements through all media channels. This announcement would advise people that there has been an accident and advise that people stay indoors, close all doors and windows and eat only canned food. However, this is a temporary measure. The U.S. Enviromental Protection Agency points out that:

> "Generally, shelter provided by dwellings with windows and doors closed and ventilation turned off would provide good protection from inhalation of gases and vapors for a short period (ie one hour or less) but would be generally ineffective after about two hours due to natural ventilation of the shelter."

Distribution of Potassium Iodate Tablets

The Schemes plan to automatically distribute potassium iodate tablets to everyone within a 550 metre zone around the submarine as they are being evacuated.

These tablets are issued to prevent irradiation of the human thyroid gland through either ingestion or inhalation of any form of radioactive iodine. The tablets work by saturating the thyroid gland with stable (non-radioactive) iodine, this prevents the gland from taking in any other form of iodine. However, these tablets do not prevent external irradiation of the thyroid gland.

The tablets themselves can have adverse health effects (eg iodine sensitivities possible effects on the developing thyroid in the fetus, effects on those with potentially over-active thyroids). These tablets can therefore only b distributed to members of the general public on the authority of a District Medical Officer and usually only when the benefits far outweigh the risks.

In order to be effective tablets have to be administered immediately before or at the time of exposure to any form of radioiodine. In order to be 100 percent effective they have to be distributed to everyone who could be at risk, within one hour of a release of radioactivity occuring.

> "It has been shown experimentally that a dose of 100mg of potassium iodide is virtually 100% effective if taken immediately before or at the time of exposure to radioiodine, 75% effective if taken 1.5h afterwards, and 50% effective if taken 5.5h later."

If we take the W. Jackson Davies figure of a 5km minimum evacuation distance and assume that this is impossible immediately. We have to find a way of delaying the effects of radiation to all the people within that area. As a temporary measure, sheltering and distribution of potassium iodate tablets would be adequate. This, however, is quite an undertaking.

Lets assume that there are 100,000 people living in 30,000 houses within 5 kilometres of the scene of an accident and that all these households are at risk. Lets also assume that it takes only five minutes for a multilingual distributor to explain dosage, side effects etc, and overcome any objections. One hundred and four distributors could conceivably do the job in 24 hours. In order to complete the task within one hour it would take 2500 distributors equipped and ready to move the instant a release occurs.

There is no mention in any Scheme presently in place of where distributors are to be found after an accident. Even if enough distributors are found, there are additional problems.

The distributors will be the first figures of authority to face members of the public. They will be faced with people in various emotional states and even the calmest of them would probably have the mildest curiosity as to what the tablets are, their purpose etc. Distributors could be greeted with the following questions:

*I'm allergic to Iodine. What should I do?

*My child has been vomiting. What happens if it cannot keep them down?

*I suffer from lupus and I shouldn't take these tablets. What should I do?

*I already take thyroid tablets. Should I stop?

*I'm pregnant and shouldn't take anything. Is it alright to take these?

*We've just had six pints. Can these be mixed with alcohol?

Unless every distributor is a member of the medical profession, they will be unable to answer any questions with any degree of authority.

There is a leaflet in all Schemes that is to be handed to members of the public when distributors are handing out potassium iodate tablets. It explains very little about what the tablets are, their purpose, possible side effects etc. The leaflet, very briefly, explains what dose to take, that the tablets are perfectly safe and that you have to stay indoors until further notice. People receiving this leaflet are then meant to pin this leaflet prominently on their front door.

Does the Royal Navy seriously beleive that someone will answer their front door to someone dressed in protective clothing, take a leaflet and the correct amount of tablets, and then pin the notice on their front door without any comment whatsoever.

The leaflet is only printed in one language, English. There is no mention of the possibility of it being translated into any other language. This could present a major problem to distributors in cities such as Cardiff, Liverpool and Southampton.

It should be remembered that all this preperation would be for just 1% of the total amount of radioactivity that would be released in an accident. Other, as serious, radioactive materials would be released in larger quantities. These materials include cesium and strontium.

Consequences of a Reactor Accident

W. Jackson Davies study into the effects of a submarine reactor accident at a Canadian port concluded that exposure to radiation after an accident would exceed reccomended levels by hundreds to thousands of times. This would cause hundreds to thousands of long term cancer casualties unless the city was rapidly evacuated. Decontamination of the city could cost tens of billions of US dollars and take months to complete, during which time the local economy would cease to function.

Even the most minor of accidents envisaged by the Royal Navy would have serious consequences for the area in close proximity to the submarine. The problem is a phenomona known as 'Gamma-Shine'.

> ".....the fission products that would be liberated would give off gamma radiation of such high energies that even if the fission products remained contained within the sealed primary coolant systemsthe radiation would nonetheless penetrate both the primary and the secondary containments and still be of sufficient intensity to pose a hazard to health of those within the immediate vicinity of the submarine."

This intense form of gamma radiation is commonly known as 'Gamma-Shine', and people are warned that no form of shelter is adequate enough to protect people from it. The immediate vicinity is a maximum of 50 metres in air and 5 metres in water, and is known as the exclusion distance. Such an exclusion distance would have drastic consequence for many of the places that have Z-Berths, closing civilian docks and shipbuilding yards and ruining beautiful Scottish lochs. The knock-on economic consequences of this could also be drastic.

CONCLUSION

The present Royal Navy Public Safety Schemes are based on minimal assumptions about the nature of a nuclear reactor accident onboard a submarine and provide only modest countermeasures to deal with such an accident. It is unlikely that these Schemes would provide effective protection to the public in the event of such an accident.

Visits by nuclear powered submarines to any area provide no more benefit to the local community than a visit by a normal conventionally powered warship. Given the possible severe consequences of a nuclear reactor accident and the uncertainties surrounding the chances of such an accident, the risk associated with nuclear powered submarine visits appears to be unacceptably high to any local community.

Footnote:
This analysis is very basic and only covers some of the major areas of concern in Royal Navy Public Safety Schemes, there are many other problems with these schemes that have not been mentioned.

References:

1) Nuclear Accidents on Military Vessels in Canadian Ports: Site Specific Analyses for Esquimalt/Victoria by W. Jackson Davies Ph.D

2) Manual of Protective Action Guides and Protective Actions for Nuclear Incidents. US Enviromental Protection Agency, Office of Radiation Programs.

3) Journal of Radiological Protection, 1988, Vol.B, No4 pgs 197 - 207

4) Health Service Arrangements for Dealing with Accidents Involving Radioactivity.

5) Numerous Royal Navy Public Safety Schemes.

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