Williams Speech to Cost of Trident Conference. June 92

HOW WIDESPREAD WOULD CONTAMINATION FROM A NUCLEAR REACTOR ACCIDENT BE?

The consequences of a nuclear reactor accident depend on the severity of the accident; the type and quantity of radioactive material released to the environment, and the length of time over which the release takes place. The number of people exposed to the resulting radioactivity and the dosage they receive largely depends on the prevailing weather conditions; how close they are to the accident; how quickly countermeasures are introduced to protect the public and how effective they are.

The Royal Navy estimate that even in the worst imaginable nuclear reactor accident radioactive materials would spread no further than ten kilometres from the scene. Their emergency planning zone for the most likely accident is only 550 metres and does not take local populations into account.

However, in a study by W. Jackson Davies, Ph.D., he considered the likely consequences of a major 100 MegaWatt naval nuclear reactor accident in Sydney and Freemantle, Australia.

It was found that the Federal limits for exposure to radiation was exceeded by approximately five hundred to ten thousand out to twenty kilometres from the site. Normal background levels of radiation would be exceeded by eighty thousand to five million times out to as far as seventy kilometres from the scene of the accident.

SPEECH TO "COST OF TRIDENT" CONFERENCE, GLASGOW, 10 JUNE 1992
041-248-2656.

NUCLEAR WEAPONS AND THE ENVIRONMENT

INTRODUCTION

Trident is a system that deploys unsafe nuclear warheads ontop of a missile, the fuel of which is highly volatile, then places not just one but up to 128 warheads, containing an estimated 496 kilograms of plutonium in toto, and 16 missiles, weighing over 100,000 lbs each, into a submarine that is powered by a nuclear reactor. It is a dangerous and potentially lethal combination in any accident, and a constant threat to the environment.

The effects nuclear weapons have on the environment are wideranging and in this brief paper I hope to outline some of the most important. Behind every nuclear weapon is a complex infrastructure of manufacture and servicing facilities each having their own environmental effect and waste by-products.

WARHEAD PRODUCTION

A nuclear warhead is a highly radioactive and toxic cocktail of materials. All of these materials have to be produced or mined, then milled, machined and manufactured into components for nuclear weapons. All these processes produce toxic and nuclear waste and all subject workers, people around the plants and the environment to radiation.

Radioactive materials are routinely discharged into the environment as a result of these processes. Toxic and radioactive waste is produced and either disposed of or stored. All of these materials have to be transported to one place or another resulting in the exposure of far more people to a risk of some form of nuclear or toxic release.

WARHEAD TRANSPORTATION

Trident warheads will soon be regularly transported along British roads amidst intense secrecy. There could be as many as one nuclear warhead convoy every month, possibly even one every fortnight, along highways between Burghfield near Reading and Coulport, only 30 miles from this conference.

The manufacture of a nuclear weapon involves the assembling of over 2,000 separate components, which are produced at sites all over Britain.

The final assembly of all these components takes place at the Atomic Weapons Establishment, Burghfield. When completed and checked, a nuclear convoy will deliver the Trident warheads to the Royal Naval Armaments Depot at Coulport.

All radioactive materials decay with time and nuclear warhead components are no exception. This means that the warheads themselves have a limited shelf life, after which they need to be overhauled or refurbished and this is the main reason why they are transported.

The weapons are overhauled at their site of assembly, AWE Burghfield. Here the weapons are stripped down, the fissile components are sent for refurbishment and the electronic components are checked and replaced if necessary. The warhead is then rebuilt and returned to its operational site, which in the case of Trident is the Royal Naval armaments Depot at Coulport.

WARHEAD and MISSILE SAFETY

In December, 1990 a panel of eminent American scientists, appointed by Congress, reported on their investigation into US nuclear weapons safety. The panel was headed by Dr Sydney Drell and their report has become known as "the Drell Report". The findings were alarming.

The Drell panel expressed concern that serious safety issues, known, for at least a decade, have not been dealt with. They found that many nuclear weapons in the US stockpile did not meet present design criteria. Further, they discovered with the aid of new computer modelling techniques that "unintended nuclear detonations present a greater risk than previously estimated (and believed)" for some US nuclear weapons.

This meant that the possibility of a nuclear explosion in an accident involving nuclear weapons could no longer be ruled out.

Weaknesses in nuclear warhead safety practice was attributed to "the chilling environment of the Cold War" where the priority was not designing the safest warhead but obtaining the smallest, lightest warhead with the largest yield.

The Trident missile and its warhead was one of the weapons that received special attention by the panel. The Drell report called for an urgent rethink into the way the Trident missile system was designed.

The problem with the warhead for Trident is that in order to make it smaller and lighter, normal high explosives were used in both the W76 and the W88 - the two US warheads that can be deployed on Trident missiles. The alternative would have been to use "Insensitive High Explosives" or IHE which are relatively impervious to fire, shock, crushing etc, this type of explosive is, however, denser and heavier than normal high explosives, and as such would increase missile weight and reduce missile range.

The problem with the missile design is two-fold. Firstly, the rocket motors use the most volatile missile fuel available and secondly, rather than placing the warheads above the third stage rocket motor they are arranged in a ring around it with no fire-shield between the two components.

This combination of high explosive that can burn and detonate in an accident, missile propellant that can also burn and detonate, and no protection between missile and warhead, means that the chance of an accident resulting in major consequences with widespread scattering of radioactive materials or even a nuclear explosion is far greater than for many other nuclear weapons systems.

These problems identified in the US, apply to the UK Trident system as we are merely renting missiles from them. Although the UK Trident warhead is designed and built in the UK there has been a great deal of US assistance. The likelihood is that with both US Trident warheads employing normal high explosives as a trigger, UK designers will have followed suit.

If this is the case then the Trident warheads soon to be transported within the UK will be more susceptible to explosion or fire, possibly resulting in the widespread release of radioactive materials to the environment, if a serious accident was to occur.

When placed on board the submarine there are added dangers because in the event of fire or explosion not only would all the volatile missile fuel and nuclear warheads be present but a nuclear reactor with its own associated hazards is then located next to the missiles.

TRIDENT'S NUCLEAR REACTOR

The Trident submarine is powered by a Pressurised-Water reactor, a 100 mega-watt nuclear power station.

Submarine propulsion systems, because of their size, mobility and the hostile environment in which they must operate, are exposed to substantially greater risks than land-based nuclear power stations; potential accident situations are appreciably more

ACCIDENT HAZARDS

Little is known about the accident scenarios the Royal Navy plan for. In the select details that have been published there is no technical or engineering data to justify their selection, or probability statistics (which are in any case extremely vague), or their radioactive material release estimates.

Worldwide, between 1954 and 1988, there were some 200 accidents involving nuclear powered submarines, 50 of them involved ballistic missile submarines.

There are at present eight nuclear reactors and fifty nuclear warheads on the ocean beds of the world as a result of accidents.

An indication of the real risks may be gained from a series of articles in the Journal of Naval Science, written by and for the Royal Navy, which reveals that there were 712 incidents involving submarine nuclear reactors between 1964 and 1978 - an average of roughly one a week; between 1973 and 1978 there were 106 'reactor scrams' - a rough average of one every ten weeks.

These articles also state that the Royal Navy have a 'spurious scram' once every 4 months on average. These are described as reactor shut-downs 'which can only be attributed to an irresponsible malfunction of the Reactor Protection System', and are said to be 'mercifully rare'. This may be indicative of Navy thinking that a malfunction is considered to be irresponsible rather than the processes which lead to it.

Another indication of the real accident record of the world's navies has recently been revealed through a number of developments.

Firstly, the General Headquarters of the Russian Navy a few days ago released a report on accidents that have occurred on board their vessels over the last five years.

The most comprehensive listing until now of accidents involving the world's navies was the Greenpeace Report "Naval Accidents 1945-1988"

The Russian Navy report shows that the Greenpeace report was merely the tip of the iceberg as far as accidents involving naval vessels were concerned.

The report lists 46 separate accidents, whilst the Greenpeace report listed only 12 during the same period.

Now, I know it will be suggested that the Russian Navy has more accidents than the US or western European navies. This has been refuted by Admiral Valery Alexin, Chief Navigator and head of the Russian Navy Press Cemtre. He is reported as having said:

"No, the accident rate in this country does not exceed the amount of accidents abroad and some accident indexes are even lower."

The fact that public accident records are nowhere near complete is backed up by two new incidents involving Royal Navy nuclear powered submarines, uncovered by a Plymouth newspaper, the "Evening Herald", only last week.

The first happened in 1986 where HMS Splendid is believed to have snagged its towed array sonar equipment in the Norwegian Trench. The towed array was ripped off.

The second happened less than three months ago when HMS Valiant struck an underwater mountain in the same Norwegian Trench. The collision dented the submarine's main ballast tank but luckily did not pierce it. If this had happened the submarine could have sunk to the bottom of the sea.

Greenpeace therefore feels that following the Russian Navy's example, the Royal Navy should immediately release a full list of accidents involving their ships from 1987 to date.

Until this is done a complete assessment of the hazards of continuing to operate a nuclear powered submarine fleet cannot be carried out.

William Peden, June 1992

numerous because of the possibilities of collision, fire, sinking, grounding, stranding, and sea effects etc.

The restricted amount of space in a submarine, means that shielding has been sacrificed to reduce weight and increase speed and manoeuverability. Safety systems that are standard in civil nuclear plants necessarily have to be omitted or reduced.

In a normal civil reactor, the final containment consists of extremely thick concrete walls which are unlikely to melt and difficult to breach. The final containment in a submarine is simply the steel hull which has a relatively low temperature melting point and which can be easily breached in an explosion or collision.

Delegates here today will be familiar with the accident record of the civil nuclear industry. The Royal Navy's record is seemingly little better, although all accidents involving nuclear powered submarines are shrouded in secrecy.

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FIRE ONBOARD A SUBMARINE

Fire has always been a major hazard in any warship packed with electrical equipment and employing oil and steam at high temperatures. In a submarine this situation is exacerbated by the contained atmosphere and even more cramped conditions.

Fire is the greatest danger to a nuclear warhead and missile propellant for reasons previously outlined. Explosives and propellant can burn and explode. The reactor and its safety systems can also be damaged. Nobody knows what damage could be caused to the nuclear reactor by the explosion of ballistic missiles.

Fire is not an unknown event onboard submarines. In 1976 HMS Warspite suffered a fire in its backup diesel generating room whilst berthed in Liverpool. Three people were injured and the damage caused took over three years to repair at a cost of over 5 million pounds. A couple of months ago HMS Turbulent suffered a fire in the switchroom next door to the reactor compartment, the reactor was "scrammed" and over twenty three people were injured. The extent of damage to the submarine remains unknown.

WHAT WOULD HAPPEN IF FIRE WERE TO ENGULF A NUCLEAR WEAPON OR WEAPONS?

If there was no concentrated firefighting effort, it is probable that the explosive contents of a nuclear weapon and/or their components would burn and/or detonate and a release of radioactive and toxic materials would occur.

It should be noted here that if the missile propellant were to also be involved in a fire it would burn at temperatures of two thousand to four thousand degrees celcius until the propellant is spent. This is hot enough to incinerate steel and the majority of components inside any nuclear weapon.

The two components of a nuclear weapon which constitute the major hazard in an accident are the high explosive; and the fissile nuclear material. The greatest danger to these major components in an accident is fire. Depending on the type of weapon the high explosive surrounding the fissile core could burn and explode in a severe ship fire.

According to official US military manuals, if fire were to engulf a nuclear weapon firefighters would have only five minutes to extinguish it. If this could not be done, and it seems unlikely that in such circumstances it could, then the fire must be controlled and allowed to burn out.

Assuming no nuclear explosion, the radiological hazard associated with an accident arises from the release of radioactive contaminants by burning or chemical high explosive detonation of the nuclear weapon. Contaminants released to the atmosphere would include plutonium, uranium, tritium, lithium, thorium, beryllium as well as quantities of lead and plastic.

HOW WIDESPREAD WOULD CONTAMINATION BE FROM A NUCLEAR WEAPONS ACCIDENT?

Wind velocity and other meteorological conditions, the height of the cloud or plume containing the radioactive material, and terrain all influence the extent to which contamination may be transported from the immediate vicinity of the accident site.

A report by the General Accounting Office using data from a specifically designed Atmospheric Release Advisory Capability computer to evaluate weather conditions, type of accident and other conditions, revealed the following estimate:

a) 0.45 Sq Kms - evacuation recommended
b) 11.41 Sq Kms - sheltering recommended, evacuation should be considered
c) 134.71 Sq Kms - general public annual whole body dose exceeded, consider sheltering.

The Drell Report itself concluded that in the event of a detonation of the High Explosive (HE) in a typical nuclear bomb or warhead an area of approximately 100 square kilometres downwind could be contaminated. They also estimated that the cost of cleaning up such contamination would be upwards of $500 million.

Clearly, radioactive materials if released in a nuclear weapons accident would cause severe environmental damage over a very large area.

This damage would be long-lived because many of the radioactive materials in nuclear weapons have "half lives" of thousands of years and, unless removed, will continue to contaminate an accident area for a long time after any accident.

This study estimated up to 914 short term casualties (on the first day) in an area up to 45 kilometres from an accident. In the long term this level of radiological release would cause up to 1,718 additional cancer casualties, one year after after the accident occurred. For every year after that there could be as many as 659 additional casualties.

Naval nuclear reactor accident response plans exist, but they are not prepared to respond to a severe accident and are likely to be of little value in such an event. Planning weaknesses include official radiological release estimates which do not bear close scrutiny; no detailed planning for the distribution of potassium iodate tablets to the public (a vital protective measure to prevent take up of radioactive iodine) have been undertaken; and plans for monitoring a radioactive release to the environment and overall control procedures to deal with any accident have not been explained in detail.

Nuclear weapons accident response plans do not publicly exist. What information that can be gleaned from past exercises designed to test these plans, do not instill confidence that a nuclear weapons accident can be adequately dealt with.

There are no known response plans to deal with the combined effects of a potential missile/warhead plus reactor accident onboard a Polaris or Trident submarine.

ROUTINE OPERATIONS

As mentioned previously warheads and missiles are routinely serviced. Submarine nuclear reactors also require maintenance.

Inspection, maintenance and repair of submarine nuclear reactor systems result in radiation doses to workers and nuclear waste. Fuel rods when spent are sent for storage or reprocessing to Sellafield. Liquid radioactive waste is routinely discharged into the marine environment. Solid radioactive waste is either stored on site or sent to the national disposal site at Drigg.

END OF OPERATIONAL LIFE

The disposal of nuclear reactors when they have reached the end of their operational life present a further problem.

There are already seven nuclear powered submarines awaiting disposal in this country. The MoD has no policy to dispose of them. Worldwide more than 250 nuclear powered submarines will need to de disposed of over the next twenty years.

This is yet another radioactive waste problem left for future generations to cope with.

William Peden, June 1992