ALDE OPEN HEARING

NUCLEAR SAFETY AND NUCLEAR POLICY AFTER FUKUSHIMA DAIICHI

INTERVENTION OF

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LONDON

IMPLICATIONS FOR THE WORLD-WIDE NUCLEAR REGULATORY REGIMES – SPECIFIC APPLICATION TO EUROPE

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FUKUSHIMA
IMPLICATIONS FOR THE WORLD WIDE NUCLEAR REGULATORY REGIMES

Parliamentarians:-

I am John Large, a Chartered Consulting Engineering, a Fellow of the Institution of Mechanical Engineers, Graduate Member of the Institution of Civil Engineers, Member of the Nuclear Institute and Fellow of the Royal Society of Arts.

Previously, from the late 1960s through to the late 1980s, I was a member of the academic research and teaching staff at Brunel University where I undertook postgraduate research on behalf of the United Kingdom Atomic Energy Authority.

From the late 1980s, I have been Chief Executive of the Consulting Engineers Large & Associates specialising in nuclear systems analysis and, particularly, assessment of the failure of engineered systems. In this role, I headed up the team of nuclear and weapons experts tasked to assess the nuclear risks and hazards throughout the salvage of the Russian Federation nuclear powered submarine Kursk; I have personally given evidence to the United Kingdom, Italian, French, United States, New Zealand, South African and other government authorities on nuclear matters; and I am presently undertaking a detailed assessment of the recent and ongoing incidents at the Fukushima nuclear power plant.

Relating to my intervention here today, I have visited and reported upon the very severe accident and radiological consequences arising from the Chernobyl N^{o} 4 nuclear power plant, and I have been involved first hand in the aftermath other serious radiological situations in the former Soviet Union with the nuclear powered and armed submarines in the Kola Peninsular and at the Soviet military-industrial plants at Tomsk, Sverlovsk and elsewhere in the former Soviets, Republics and Territories.

Of course, because not all radiological incidents and accidents are confined to the former Soviets, my experience includes involvement with the year-long repairs to the Royal Navy nuclear powered submarine HMS *Tireless* when stranded at Gibraltar with a severe reactor defect; assessment of a number of radiological situations in the United Kingdom; and for an international organisation analysis of the fissile materials production programmes in the Middle East, including separate assessments of the Iraqi Tuwatha nuclear complex that was devastated by Allied action in the second Gulf war.

Now I turn to recent events at Fukushima N^{o} 1 nuclear complex.

We have all been kept abreast of the developing situation at Fukushima on a daily and hourly basis by what might be best described as a feeding frenzy by the media and press. Some of this reporting has been grossly misleading; some expert opinion broadcast has been unqualified and downright incorrect; the Japanese government has been confused and taciturn in its management and release of factual information; and rapid and reliable information exchange has been beset with language and, to some extent, cultural difficulties.

What we do know is that a series of serious radiological situations have developed and persist at the Fukushima N^{O} 1 nuclear power complex.

Two distinctive abnormal events have occurred:

Firstly, triggered by seismic trips, all three operating reactors shut down automatically but thereafter denied means of cooling, the fuel cores have entered a progressive melt situation which in turn resulted in violent explosion:

For the first and third of these reactors the explosion resulted in very substantial damage to the higher reactor servicing area, including the fuel ponds holding the spent and highly radioactive fuel, and rendering continuing surety of reactor containments somewhat doubtful. The radioactive discharges from the third reactor are of particular concern because, unlike the other reactor plants, it was partially fuelled with a plutonium based mix oxide fuel. The second reactor sustained and apparently contained an internal explosion, but now, like the other two reactor blocks, it also seems to be expelling a radioactivity to the atmosphere.

Secondly, the fourth explosion related not to the reactor but to the spent fuel storage pond housed in Reactor Block 4 – this was an entirely different event to the three previous explosions. This explosion devastated the containment and, no doubt, ejected spent fuel fragments around the Fukushima nuclear complex site, thereby rendering the radiological environment extremely hostile to the degree that access to the site overall remains radiologically challenging.

Both of these events, the three reactor explosions and the fuel pond criticality incident, were very serious – continuing emergency management is required on and around the Fukushima site, a very large number of people, upwards of 200,000 have been evacuated and will need to remain evacuated from around the region, and there is great uncertainty about the level of radioactive release to date, the potential for further release over the next few days and weeks and, with it, significant risk to the health and the wellbeing of a very large urban population, stretching into the Tokyo conurbation of 35 million or thereabouts population.

What is known is that just a few seconds of severe earthquake led to catastrophic failure of 4 nuclear power plants, the contamination of the entire Fukushima nuclear complex and, as announced by the Japanese government, the abandonment of one of the World's largest nuclear power plant sites of six nuclear power plants. A very preliminary estimate of the cost of containing the nuclear plants and spent fuel, cleaning up the site, and replacing the lost 4.7GW_e generating capacity might be of the order 40 to 50 € billion.

If the radioactive contamination has spread significantly beyond the Fukushima N^o 1 nuclear power complex, which seems to be the case, then the cost and health consequences could be very significant indeed. A number of signature fission products have been detected at three locations relatively remote from Fukushima, of these Caesium-137 might have derived from either the reactor and or spent fuel explosions, the Iodine-131 most likely was emitted during the reactor explosions but, as yet, no signature actinides or fission products from the plutonium based mixed oxide fuel in N^o 3 reactor.

Now, Parliamentarians, allow me to examine the reason why the Japanese population is faced with what seems to be a very serious radiological calamity.

I will argue that much the same institutional failings apply to the Fukushima nuclear complex accident as those Soviet nuclear catastrophes that I touched upon earlier. If this premise is correct, then the question posed is, surely, how Japan, an acknowledged highly sophisticated, technological society, could have suffered the same institutional failings of the lumbering and then collapsing autocratic giant of the Soviets?

I will present my opinion and strong belief that the Fukushima failures derived from a fundamentally flawed nuclear regulatory system as installed and practised in Japan.

Indeed, the nuclear safety regulatory system is international, adopting throughout much the same codes of practice, internationally approved radiation dose regimes, risk and hazards definitions, and assessment procedures. For example, we in Europe like other regulators world-wide, adopt the same recommendations on dose limitations from the International Committee on Radiological Protection; the same International Atomic Energy Agency, the IAEA, standards are adopted for seismic or earthquake loading; we use the same ASME engineering codes to determine the strength and resilience of the nuclear reactor pressure vessels, be these for pressurised water, boiling water, or heavy water moderated variants of nuclear power plants, and so forth and so on.

Such is the consistency and universality of the nuclear safety regulatory regime that different national regulators are able to group together to exchange and strengthen this consistency of approach. For example, we in the European Community have formed the *European Nuclear Safety Regulators Group*, comprising membership of all twenty seven European Community states, irrespective of whether they individually generate electricity by nuclear power. This consistency of approach to nuclear safety means that a regulator, say, from Autorité de Sûreté Nucléaire of France could easily exchange places with a counterpart from the United Kingdom's HM Nuclear Installations Inspectorate.

Indeed, either of these two national nuclear regulators, or another regulator drawn from any of the sixteen states that operate nuclear power plants in the European Community, would feel perfectly comfortable swapping places with his or her counterpart in Japan.

This brings me to the core issue of my intervention here today.

I will argue strongly, indeed I will assert, that what happened at the Fukushima N^{o} 1 nuclear power complex in Japan, is not just the tragic and costly outcome of an engineering failure, as a result of malfunctioning piece of equipment, or of some generic feature of the boiling water reactor, being overwhelmed in that particular locality and at that particular time, by the earthquake and possibly a following tsunami.

In other words, the Fukushima accident was a failure of the very regulatory system itself – it was an institutional failure.

Moreover, because of the universality of the international nuclear safety regulatory system, this failure of a nuclear system at Fukushima in Japan could equally, *as chance would have it*, be repeated elsewhere, say in the United States, in Britain, France or indeed in any one of the sixteen European Community states that operate nuclear power plants.

'As chance would have it' is the basis of the nuclear safety regulatory framework promoted and promulgated by the International Atomic Energy Agency to be subsumed into national regulatory codes. More fancifully, it is referred to as *'probabilistic risk'* assessment that forms the basis of the compact *'Acceptable Risk and Tolerable Consequence'* that determines whether the fault condition performance of a nuclear plant is acceptable.

This compact works both ways:

The risk of the occurrence of an accident must be acceptable, it must not be unacceptably often, and if an accident does occur then the radiological consequences must be tolerable. So more frequently occurring incidents and faults must be countered by enhancement of the resilience of the nuclear plant, say, by extra safety systems and or more robust engineered structures of the pant itself.

However, if the chance or risk of a severely damaging event is so remote, so infrequent to be considered *incredible* that it is most unlikely ever to occur. It logically follows, in the mind of the nuclear regulator at least, there is no need to engineer into the plant any special countermeasure, strength or additional safety system.

As chance would have it, this means that the risk an iceberg, representing but a tiny speck in the vast geographical space of the North Atlantic, colliding with an even smaller speck of a transatlantic liner would be so remote, so infrequent as to be an incredible. Hence, there would be no need to render the SS *Titanic* unsinkable or to equip it with lifeboats before it sailed on its ill-fated maiden voyage.

So, for Fukushima, the Japanese regulator had to predict the risk of a severe earthquake striking the plant; he would have to foresee that the Fukushima complex along with another 10 or so nuclear plants would automatically shut down at the first tremor, and for this particular shallow epicentred earthquake the individual plants would each shut down virtually simultaneously; and that this immediate loss of power input would befuddle the electricity distribution grid to collapse, denying those same nuclear power plants essential electricity supplies to maintain cooling of the reactor fuel cores and spent fuel ponds; and he would have to ensured that on-site emergency supplies, the diesel generators would start and would not be overwhelmed by the tsunami that followed.

Of course, in licensing the Fukushima nuclear complex the nuclear regulator in Japan, like his counterparts in the European Community, would have followed through this then hypothetical cascade of events – he would have calculated the risk of occurrence of each element, its interaction with preceding and subsequent events, to arrive at an overall probability or risk for the cascade running uninterrupted to completion.

We now know because Fukushima failed the acid test, that the Japanese regulator must have considered the earthquake-tsunami cascade to have been an incredible event, so low in frequency of occurrence that both it and any special measures to safeguard the Fukushima plant could be ignored.

Because the earthquake-tsunami cascade was discounted on probabilistic reasoning alone, no plans were laid to respond to the inevitable failure of three nuclear reactors and at least one spent nuclear fuel pond at the Fukushima nuclear complex. This absence of forward planning and preparation reflects in the expedient and mostly ad lib post-accident control actions now being undertaken at Fukushima – the absurdity of helicopters water bombing the smoking hulks of four reactor buildings, the resort to riot control water cannon being deployed as the only means to cool melting nuclear fuel, senior managers of TEPCO publicly arguing with government officials, and the introduction of radiation dose controls at the threshold of acute exposure for those courageous workers tackling a largely unknown and unplanned for situation. This, I put to you, is a disturbing insight into the so obviously flawed nuclear safety culture based on as *chance would have it* alone.

This endemic failing of the nuclear safety culture applies equally to the regulation of each of the one hundred and forty three (143) nuclear power plants operating in the European Community states.

The European Commission determined at the special meeting of 15 March that *'stress testing'* of the nuclear power plants would be sensible and prudent, but just what is meant by the *'stress test'* remains unclear.

To my mind, my resolute recommendation is that it is absolutely essential that the European Energy Commissioner, Günther Oettinger, implement immediate pro-active action that not confined only to a re-assessment of the European Community nuclear power plants, nuclear fuel and other facilities, but also carries through a fundamental, root and branch examination of the same nuclear safety culture that has so catastrophically failed in Japan.

And one final point: who is to undertake this root–and-branch analysis of a flawed and failed regulatory system – surely, not the regulators themselves for they have failed at Fukushima and, *as chance would have it*, they themselves are vulnerable to failure here in the European Community.

Finally, Parliamentarians, permit me to express my sympathy for the people of Japan in their suffering, caused by this national calamity of earthquake and tsunami, that has so harshly beset their nation.

Thank you.

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