IMPLICATIONS OF THE NUCLEAR CRISIS AT FUKUSHIMA DAIICHI JAPAN FOR THE UNITED KINGDOM'S NUCLEAR POWER PLANT (NPP) NEW BUILD PROGRAMME

INSTITUTION OF OCCUPATIONAL SAFETY AND HEALTH
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Following the *Tohoku-Taiheiyou-Oki* earthquake-tsunami, when the Fukushima Daiichi nuclear power complex lost all off- and on-site power, going into electrical *blackout*, the loss of cooling to the nuclear reactors of Units 1, 2 and 3 resulted in each nuclear fuel core being exposed, overheating and melting. Accompanying the meltdown, for Units 1 and 3 the secondary containment structure was utterly devastated by deflagration of hydrogen accumulating in the charge hall. What fuelled the explosion within Unit 2 remains unclear but, in any case, it was of sufficient force to blow out a sizeable outer panel of the containment building, suggesting that it may have breached both primary and secondary containments of the reactor building at above and, as learnt later by the very significant contamination of the flooded underground services ducts, at a sub-basement levels. Prior to the earthquake, the Unit 4 reactor had been shut down and completely defueled with the nuclear fuel transferred to the water filled spent fuel pond located at the higher level of the reactor block. Somehow, hydrogen generated by the fuel clad Zircaloy and steam reaction of Unit 3 reactor, accumulated in Unit 4 to deflagrate and a split second later violently explode devastating the charge hall and lower levels of the building primary containment, leaving the 250 or so tonnes or intensely radioactive fuel in the damaged spent fuel pond structure at peril – a precarious situation that remains today.

Acting quickly, within two weeks of the Fukushima Daiichi incident the European Union Council invited Member States to review the safety of all EU nuclear plants in accord with the recommendations of EU Commission and *European Nuclear Safety Regulatory Group* (ENSREG). The EUC-ENSREG joint declaration set out the basic requirement of *'stress tests'* that each national regulatory authority required its licensees (NPP operators) to undertake comprehensive risk and safety assessments covering extraordinary triggering events such as earthquakes and flooding, and the consequences of any other initiating events, including aircraft crash and terrorist act, that could lead to multiple loss of safety functions necessitating severe accident management procedures.[1]

With his illustrated presentation John Large will, first, explain the devastating accident at Fukushima Daiichi and then, in the context of the lessons learnt, scrutinise the fundamental approach adopted worldwide for both defining and determining nuclear safety at operational and for the present round of new-build nuclear power plants in the United Kingdom. This approach, centring around probabilistic risk analysis or *'as chance will have it'*, is shown to be deeply flawed and identifies the lessons to be learnt from the historic record of past failures of engineering endeavours, such as SS *Titanic*, the space shuttle disasters of *Challenger* and *Columbia*, and offshore oil platforms such as *Piper Alpha* and the *Deepwater Horizon*, as well as the string of nuclear catastrophes including Windscale, Three-Mile Island, Chernobyl and, most recently, Fukushima Daiichi. Also examined is the reliance upon often over-prescriptive national and international (eg ENSREG, IAEA etc) nuclear safety inspectorates, particularly to the extent that nuclear plant designers and operators are now well versed in *'shoehorning'* their plant designs and safety procedures into compliance, effectively converting safety targets into design specifications thereby rendering the safety regulators to be engineering designers, a role for which, it is argued, they are both ill-qualified and least experienced.

Overall, John Large[2,3] will argue and demonstrate that the ongoing nuclear catastrophe at Fukushima Daiichi should be considered to be a step too far and that, belatedly, it should be taken as a lesson learnt, thereby necessitating a radical rethink and change to the ways and means by which society should control and regulate nuclear safety and, indeed, prepare for safeguarding the public in the aftermath of such a severe radiological event. By way of local example John Large will compare the emergency response necessitated at Fukushima, stretching out to 60+km with 140,000 individuals evacuated, some forcedly, and with a 20km radius total exclusion remaining today, to the prepared emergency plans for the Aldermaston nuclear weapons plant, near Reading, which extend no further than 3km and considers the evacuation of only a few hundreds of individuals will be necessary following the most extreme of radiological incidents.

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1 Because security risks (ie terrorist attack) is beyond the scope of several ENSREG member states, the EU Council has established a working group to deal with malevolent issues and terrorist attacks, including aircraft crash – see ENSREG statement of 23 May 2011.

2 John H Large is a Consulting Engineer, Chartered Engineer, Fellow of the Institution of Mechanical Engineers, Graduate Member of the Institution Civil Engineers, and a Fellow of the Royal Society of Arts. From the late 1960s through to the late 1980s John Large was a full-time member of the academic staff at Brunel University. In the mid-1980s, he founded and headed the Large & Associates, Consulting Engineers specialising in nuclear technology and its applications. John Large and Large & Associates have been engaged by a number of overseas states and agencies, including the New Zealand Government, the Governments of Gibraltar, South Korea, Italy, Bulgaria, the Russian Federation, the Republic of Ireland, The States of Jersey, Finland and other, including the European Union to which he has presented an intervention and conference paper on the radiological incident at Fukushima Daiichi. In 2001 John Large was awarded a commemorative medal by the Russian Federation authorities for his contribution to the salvage of the sunken nuclear powered and armed submarine *Kursk*. A full bibliography of the technical reports published by John Large and Large & Associates is directly accessible at http://www.largeassociates.com/PapersReports.htm

3 http://en.wikipedia.org/wiki/John_Large - http://www.largeassociates.com/