Friends of the Earth Nuclear Network's submission to the consultation regarding the UK-ABWR Regulatory Justification Application is very much in agreement with the position adopted by the Nuclear Free Local Authorities (NFLA) and, for the most part, our position can be taken as being exactly that outlined in the NFLA's model response published in their New Nuclear Monitor, Number 35, March 2014 (copy atached):

http://www.nuclearpolicy.info/docs/nuclearmonitor/NFLA_New_Nuclear_Monitor_No35.pdf

However, there is additonal information, outlined below, which we feel ought to be considered by the Minster before making his final decision.

Negative Health Effects

1. In addition to the KiKK report and four following reports showing a statistically significant increase in childhood leukaemias in the vicinity of nuclear power stations, a further study has come to light (copy attached) , also by Dr Ian Fairlie which proposes a mechanism to explain the increase in childhood cancers amongst populations close to nuclear power plants found in over 60 epidemiological studies:

   Fairlie, I.
   A hypothesis to explain childhood cancers near nuclear power plants
   Journal of Environmental Radioactivity (2013)
   http://dx.doi.org/10.1016/j.jenvrad.2013.07.024

2. In addition to the possible sources of radiological health detriment to the public and nuclear power station workers, Friends of the Earth considers that the following studies (copies attached) showing evidence of the magnitude and extent of emissions from the UK's nuclear power station fleet should also be taken into consideration before any decision is made:

   M. Atarashi-Andoh, C. Schnabel, G. Cook, A.B. MacKenzie, A. Dougans b, R.M. Ellam, S. Freeman, C. Maden, V. Olive, H.-A. Synal, S. Xu
   $^{129}I/^{127}I$ ratios in surface waters of the English Lake District
   Applied Geochemistry 22, (2007) pp 628–636

   G T Cook, A B MacKenzie, G K P Muir1 • G Mackie, P Gulliver
   Sellafield-Derived Anthropogenic 14C in the Marine Intertidal Environment of the N.E. Irish Sea
   Radiocarbon, Vol 46, No 2, (2004), pp 877–883
   Proceedings of the 18th International Radiocarbon Conference, edited by N Beavan Athfield and R J Sparks

   R. Eigl a,*, M. Srncik a, P. Steier b, G. Wallner a
   $^{236}U/^{238}U$ and $^{240}Pu/^{239}Pu$ isotopic ratios in small (2 L) sea and river water samples
   Journal of Environmental Radioactivity 116 (2013)

Reactor Safety

Whilst it would appear that ABWR reactors are no less safe than other established designs, there are several points of concern that we would wish to raise regarding the short and long-term safety of ABWR reactors:

1. In most reactor designs, control rods are situated at the top of the reactor and

attached to the lifting machinery by electromagnets, rather than any kind of direct mechanical linkage. This means that, automatically in the event of power failure or by operator action due to failure of the lifting machinery, the control rods will fall fully into the reactor core, under gravity, to stop the reaction. However, notable exceptions to this intrinsically fail-safe mode of operation is the ABWR (and older BWR design) which have their control rods located at the bottom of the reactor and therefore require the hydraulic insertion of control rods from the base of the reactor core in the event of an emergency shut-down, using water from a tank held under high nitrogen pressure.

We wonder how such a design could ever be considered intrinsically safe requiring, as it does, the continued operation of an additional mechanism that is still capable of failure no matter how reliable or fundamentally simple its design.

2. Older BWRs have an external water recirculation circuit with a pipe inlet below the top of the reactor core. A break in this pipe would lead to a particularly hazardous situation, since the core would rapidly be exposed, as water was lost. Though modern ABWRs have internal water recirculation pumps, unlike the external water recirculation circuit of previous BWRs and avoid the risk of potentially hazardous breaks, these internal pumps necessitate additional penetrations of the reactor vessel from below, increasing complexity and increasing the difficulty of inspection during both manufacture and operation.

Although the following observations apply to older BWRs, the operating principles of ABWRs remain the same and, to the best of our knowledge, the much touted improvements to the design of boiling water reactors to create ABWRs do little to completely eliminate these risks:

1. As in a PWR, the reactor core of a BWR is located in a pressure vessel. The basic problems of the PWR vessel apply here too, but with modifications. Neutron fluxes are considerably lower than in a PWR vessel (by a factor of 10), leading to significantly less embrittlement. On the other hand, as the vessel is much larger; longitudinal welds may be required, whereas there are only circumferential welds in a PWR vessel. There is also a much more complicated inner structure rendering flawless manufacture of such vessels is particularly difficult.

2. Regulating the operation of an BWR is generally more complex than in a PWR. Under certain circumstances, the collapse of so-called steam voids in the core can lead to increasing reactivity and thus increasing power during an accident. Though BWRs, like PWRs, have a negative void coefficient, ie. when the reactor heats up and more bubbles form, the chain reaction will become weaker, creating less power, this feature can become hazardous, when steam bubbles collapse.

3. As opposed to PWRs, the coolant of BWRs generally has comparatively high oxygen content, and significant corrosion problems have been observed in many BWRs of similar basic design. In the early nineties, a vast amount of cracking was detected in a number of German BWRs, in piping of a material (stabilized austenitic steel) that was regarded as resistant to so-called stress corrosion cracking.

4. BWR containments exhibit one crucial difference from most PWRs in that even for design basis accidents (DBAs), they depend on a pressure suppression system to retain containment integrity. During an accident, the pressure suppression pool would be subject to heavy stresses. As in PWRs, beyond design basis accidents

(BDBAs) are possible that could lead to containment destruction, even with a functioning pressure suppression.

5. Even after decades of operation of BWRs, safety problems persist which have been known about and studied for a long time, and can become more acute if with new fuel types are employed. A typical example is neutron flux oscillations. Such oscillations can occur during (otherwise comparatively harmless) transients and permissible loads to fuel rod cladding may be exceeded if they are not rapidly suppressed, leading to cladding failure. In the 1980s and early 90s, several such events were observed in BWRs in Sweden, the USA, Germany and other countries. Flux oscillations later occurred at Oskarshamn-2 BWR (Sweden) and Philippsburg-1 BWR (Germany) where a new core design aiming at low neutron leakage, new fuel assemblies for higher burn-up and other changes had reduced the margin between the normal operational parameters and the instability region. At present, so-called in-phase oscillations (when the entire core oscillates in phase) seem to be sufficiently understood to be avoided. However, the measures to control out-of-phase oscillations, where parts of the core oscillate in counterphase to each other, still need to be developed further.

6. A persistent problem in BWRs which came to prominence in 2001, with the rupturing of pipes on November 7th at Hamaoka-1 BWR (Japan) and then on December 14th at Brunsbüttel BWR (Germany). The cause in both cases was an explosion of a mixture of hydrogen and oxygen, which was produced by hydrolysis in the coolant water. Oxygen and hydrogen are generated continuously during BWR operation and are present in the cooling circuit and pipes. Normally, these gases are mixed with steam and their explosive potential is therefore suppressed. However, slight changes of temperature can lead to steam condensation, leading to the formation of bubbles of oxygen and hydrogen. In the late 1980s, there were occasional problems with explosive gases collecting in German BWRs, leading to valve damage. Counter measures had previously been taken, such as the installation of recombiners and temperature monitors to allow identification of cooler zones where such bubbles might collect. Clearly, however, those measures were not sufficient, or had not been implemented to a sufficient degree at all plants and it became clear that there are basic problems in connection with the explosion hazard in BWRs which are not yet fully understood, in particular, concerning the strength of detonations if complex gas mixtures, containing other components in addition to oxygen and hydrogen, are involved.

Climate Change, Flooding and Coastal Errosion

1. Nearly all the UK’s nuclear power stations have been built on the coast to access sea water for cooling, leaving at least 11 vulnerable to rising sea levels.

Nuclear power stations at Berkeley, Gloucestershire and Bradwell, Essex are virtually at sea level, and Dungeness nuclear plant, Kent is only 2-5m (6-16ft) above sea level and at high risk from beach erosion.

Additionally, climate change induced accelerated coastal erosion may, for many sites, provide a far greater worry than sea-level rise alone, with the Sellafield complex in Cumbria and other sites, including Sizewell, Hunterston, Wylfa, and Somerset’s Hinkley Point at long-term risk.

We wonder how, given that the lifespan of a nuclear power plant from its initial construction to the return to an uncontaminated green-field site can probably be measured in centuries, there can be any justification for building additional reactors on the UK's coast.

2. Contribution to cutting carbon dioxide emissions. Given that nuclear power only generates electricity, that electricity generates only approximately 40% of our carbon dioxide emissions and that nuclear power generates 20% of our electricity, nuclear power currently reduces our carbon dioxide emissions by approximately 8%, even if we assume that the whole nuclear fuel cycle emits no carbon dioxide, a fact that is blatantly untrue. As a result, even doubling our nuclear generating capacity would only lead to a paltry 16% cut in our carbon dioxide emissions an achievement which could doubtless be achieved by the widespread adoption of even the simplest energy efficiency techniques, saving consumers money into the bargain.

   We wonder what could be achieved in the areas of energy efficiency and renewable electricity generation with the amounts of money being 'invested' in the nuclear industry.

As stated above, with the exception of the points raised above, all further points we wish to raise are more than adequately covered by NFLA's model response published in their New Nuclear Monitor, Number 35, March 2014 (copy attached):

http://www.nuclearpolicy.info/docs/nuclearmonitor/NFLA_New_Nuclear_Monitor_No35.pdf