FINAL REPORT

ON THE

ONR GENERIC DESIGN ASSESSMENT

CLIENT: WILKINSON ENVIRONMENTAL

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1ST ISSUE	REVISION NO	APPROVED	CURRENT ISSUE DATE
22 MAY 2013	R3206-I3-24-05-13-R17		**6 JUNE 2013**

FINAL REPORT - GENERIC DESIGN ASSESSMENT OF THE PROPOSED GENERATION III NUCLEAR POWER PLANTS

SUMMARY

GDA PROCESS AND PROGRESS

The Generic Design Assessment (GDA), also referred to as *pre-licensing*, aims to assess the generic safety, security and environmental aspects of new designs of nuclear power plants (NPPs). Underway since early 2008, the GDA originally considered four different Generation III NPP designs but, apart from the AREVA European Pressurized Reactor (EPR), all other Generation III NPP designs, notably the Westinghouse AP1000 and Hitachi-GE ABWR,[3] have either been suspended or completely withdrawn from the GDA process.

This Final Stage Review analyses the closing six months of the GDA process, from June through to 13 December 2012 when the *Final-Design Acceptance Compliance* (F-DAC) was granted for EPR design, although the Review reaches into March 2013 at which time the majority of the outstanding GDA Issues *Close-Out Assessment Reports* (COARs) first became publicly available.

In the month before granting of the F-DAC, the Office of Nuclear Regulation (ONR) awarded a *Nuclear Site Licence* to NNB Generation Company (an subsidiary created by EdF); then in March 2013, first, three environmental permits established the levels for emissions and, second, Planning Consent under the new Infrastructure Planning Commission was granted for the Hinkley Point C site for the construction of the UK's first EPR. Although much of the legislative infrastructure has thus been put in place paving the way for new nuclear build, there have been some setbacks including the withdrawal of EdF's partner Centrica from its 20% option for the 4 EPRs destined for Hinkley Point and Sizewell; Cumbria County Council vetoed the proposal for an underground radioactive waste disposal facility nearby Allerdale further delaying the UK's national strategy to manage radioactive waste from existing and future nuclear power plants; government has yet to agree a guarantee for long-term *'strike'* price for the electricity generated by the EPR nuclear power plants; and the other two EPR projects now at advanced stages of construction at Olkiluoto (Finland) and Flamanville (France) have encountered construction and technological difficulties that continue to setback the projected commissioning dates and which have added enormously to the overall costs.

OUTSTANDING GDA ISSUES

At the time of the Large & Associates 1st Interim Review (June 2012) there were 31 outstanding GDA Issues at the end of January-March 2012 reporting quarter – these outstanding issues spanned a diverse range of unresolved concerns across a number of sectors of the pre-construction nuclear safety case (PCSR) for EPR generic design. Certain of these GDA Issues were deep rooted, for example the concerns over the entire EPR centralised control and instrumentation strategy; other issues such as the fault studies and accident scenarios were incomplete; and the catastrophic events at the Fukushima Daiichi NPPs and, particularly, the European Commission's call for *'stress'* testing of existing and new NPP designs raised hitherto unconsidered safety concerns that, throughout 2011 and 2012, stretched the resources of both ONR and the Requesting Party (RP) EdF-AREVA.

The ONR gave an undertaking that each of these issues had to be resolved or closed-out before the ONR could proceed to grant the F-DAC. During March 2012 one outstanding GDA Issue had been closed-out, three months later as reported in the Large & Associates 2nd Interim Review (September 2012) and at the close of the April-June 2012 reporting quarter, the ONR and the *Requesting Parties* (RP) AREVA-EdF had settled just two further GDA Issues. Thereafter progress was such that another six issues were closed-out by late September, leaving the remaining 23 issues all to be settled during the month of November. Within this final group, the last 13 issues attracted a flurry of regulatory attention to be resolved just two weeks or so ahead of the granting of the F-DAC.

Although all 31 GDA Issues had been settled by posting of the somewhat perfunctory close-out letters by 13 December 2012, by far the greater number of COARs remained unpublished until March 2013. Only upon open publication of the COARs was it possible to gauge the extent to which settlement of certain information- and fact-based aspects of the GDA process had been deferred via the introduction of a large number of *Assessment Findings* (AFs).

NUMBER OF AFS RAISED IN CLOSE-OUT ASSESSMENT REPORTS (COARS)

A total of 240 AFs were raised during the settling of the outstanding GDA Issues between December 2011 and November 2012, these being in addition to the 484 AFs raised during the three year period up to the issue of the *Interim-Design Acceptance Compliance* (I-DAC) in December 2011. In the COARs dealing with the outstanding GDA Issues, the six separate *Control and Instrumentation Issues* (CI) raised a total of 53 AFs identified in the single COAR that ONR

states covers all CI issues and, similarly, across the five *Fault Studies* COARs 91 AFs were raised to be settled at some later points in the procurement and construction programme of the first EPRs at Hinkley Point C.

The *Close-Out Letter* for each of the 31 outstanding GDA Issues was published about the same time when it was settled (22 out of 31 in November 2012) but, in most instances, the respective *Close-Out Assessment Report* (COAR) was not published until about three to four months later. In fact, most of the COARs were published in March 2013 about three months following the granting date of the F-DAC. The conundrum here is whether all, some or none of the subsequently raised 240 separate AFs were established in sufficient detail for the *Close-Out Letters* to be issued and, as a whole, to justify granting of the F-DAC in mid-December 2012 - this *'chicken-before-the egg'* poser cannot be resolved with the present level and detail of information accessible in the public domain.

PURPOSE AND APPLICATION OF THE ASSESSMENT FINDINGS (AFS)

ONR's justification of the AF provision is that although the AFs are *'important safety items'* they are not considered '*critical to the decisions to start nuclear island construction'* and that the '*expectation is that they will be addressed during Phase 2 site specific projects'*. ONR also notes that the GDA process was *'not intended to provide a complete assessment of the final reactor design, as there will be other issues, operator specific or site specific, that we would expect to be considered during the environmental permitting and site licensing stages'.* This definition strongly infers that the AFs are to facilitate the settling of site- and operator-specific issues and therefore should not include for resolving generic design issues at some deferred date otherwise, it follows, the GDA would be incomplete and the F-DAC could not be granted.

By way of example, this Review considers in detail just one of the Fault Studies (FS-02) which raises an AF that requires the future licensee to *'provide a fully integrated safety case for the station blackout sequence'* in place by the time of the delivery of the mechanical, electrical and C&I safety systems to the site – a station blackout (SBO) sequence was the driving fault condition at Fukushima Daiichi during which three operational NPPs each underwent fuel core meltdown accompanied by substantial radioactive releases to the marine and atmospheric environments. Even though the ONR found that *'there is a significant amount of work still to be done to fully substantiate the safety case for the station blackout sequence'* it permitted EdF to defer its completion until the first EPR at Hinkley Point C will be well into its construction phase.

There are two points of concern arising from this example of deferring nuclear safety critical projects via the AFs into the construction and equipment procurement phases: First, and obviously, the SBO sequence and the NPP protective response to it is certainly neither a site- nor operator-specific issue – it is a fundamental generic requirement of the plant that should have been, some would argue, completely resolved within the GDA process. Second, EdF's completion of this key nuclear safety programme will remain unmonitored until it is presented to ONR for inclusion in the site-specific nuclear safety case at some unspecified date – this *'hold point'* approach to site licensing has proved to be difficult to manage at the Olkiluoto EPR and, indeed, may have compromised the Finnish nuclear safety regulator *Säteilyturvakeskus*'s (STUK) regulatory effectiveness over the Olkiluoto EPR project.

For a second example of the application of AFs, this Review generally considered the centralised Control & Instrumentation (C&I) system relating to concerns over the interconnectivity of the two computer platforms and, specifically, the relatively late (initiated in November 2009) introduction of the *non-computerised safety system* (NCSS) which aims to provide failsafe, basic fault protection measures should either or both the C&I platforms fail. The COAR dealing with this, again absolutely generic requirement of the plant, admits '*it has not been possible to perform an assessment of the high level design of this system as insufficient information has been made available within the timeframe of this [GDA]review'.* Moreover, the COAR highlights the failure of EdF-AREVA to provide information in a number of key areas on the design and function of the NCSS, so much so, that it is obvious that the detailed design of the system has yet to be completed and a prototype neither manufactured nor tested. Seven AFs have been raised further delaying the information requirement for the NCSS until well into the construction phase which raises similar concerns to those noted for the SBO example, that is the NCSS is a generic rather than a site- and/or operator-specific issue, and that deferral may lead to compromise of the regulatory process at a later stage.

CONCLUDING THE GDA PROCESS

These two examples (SBO and NCSS) raise broader concerns about the legitimacy of the role of the AF to determine the generic safety of the EPR nuclear plant in that

1) the raising of so many AFs, particularly in the FS-02 and C&I Issues, strongly suggests that the EPR design is presently incomplete and, indeed, may have stepped back in several respects since the GDA commenced because of, for example, the difficulties experienced at the Olkiluoto and Flamanville EPR construction sites, together with more stringent safety demands following the SBO triggered Fukushima

Daiichi reactor core meltdowns - with the EPR design being incomplete, or in a 'fluid' state, and the greater the shortfall in the content and clarity of the information submitted by the RP, then the more difficult the ONR GDA assessment becomes;

2) should issues such as the SBO and NCSS, which are absolutely fundamental to nuclear safety, be administered via AF deferral or should such be considered as *Regulatory Issues* (RI) leading to possible *exclusion* from the F-DAC earlier in the GDA process - the distinction between an AF and RI is that for the latter the issue is considered of sufficient importance that it would, if unresolved, *'prevent progression to the next step of the Generic Design Assessment'* thereby triggering what would have been under the original GDA scheme of things a GDA topic *Exclusion*; and

3) there seems, from the documents publicly available, no administrative mechanism by which a settled AF, that might necessitate substantial revisions to the EPR plant design or operating procedure, etc., to be incorporated into the GDA F-DAC – this is because the AFs are defined to be site- and/or operator-specific, although the SBO and NCSS examples examined are clearly generic issues - and, similarly, there seems to be no mechanism by which an unsettled AF is to be incorporated into the GDA as some form of exclusion or halt to the GDA process – put simply, the AFs allow the RP another, second or third bite of the cherry.

There is also the matter of the lack of transparency in the way in which the ONR justified the granting of the F-DAC. This relates to the fact that the *Close-Out Letters* announcing the settlement of each outstanding GDA Issue are perfunctory, containing no details of any AFs that explain the conditional basis of the particular GDA Issue achieving a 'settled' or 'closed-out' status. It is not until the publication of the respective COARs that this information is first made public which, in the majority of the outstanding GDA Issues, was three to four months later than the date of granting the F-DAC.

Also, many of the AFs first revealed in March 2013 are not required to be resolved until several years into the EPR on-site construction programme. For example, there seems to be no formal requirement for EdF-AREVA to demonstrate that the safety critical NCSS reactor shut down system will perform satisfactorily in the event of collapse of the C&I platforms, until the NCSS equipment is ready for delivery to the construction site.

In effect, this AF deferral approach has lacked transparency at the time of the F-DAC grant and, moreover, in terms of nuclear safety the final performance of the plant (functionality, risk, effectiveness of protection, etc) will not be finally settled until well into the construction and, quite possibly, commissioning phases of the first EPRs scheduled for Hinkley Point. The existence of such uncertainties together with the quite obvious incompleteness of the plant design and development, particularly in the generic safety critical areas of Fault Studies and Control & Instrumentation must have, surely, rendered the GDA process itself incomplete and inconclusive.

QUARTERLY PROGRESS REPORTS

Throughout the GDA process, since its commencement ONR has regularly published Quarterly Reports that provide a valuable insight into the trials and tribulations as well as factual matters. Importantly, the recent Q3 2012 Quarterly Progress Report provided advance information of a seismic matter raised by an AF that, otherwise, would not have become public information until at least the following January 2013, that is at a date after the F-DAC had been issued (13 December 2012) and the issue of the Nuclear Site Licence on 26 November 2012. Disappointing therefore that the ONR has decided not to publish the final Q4 2012 Quarterly Progress Report for the very active period when the final 22 outstanding GDA Issues were closed-out preferring, instead, to deal with the period by a single and particularly non-informative paragraph statement on the ONR Quarterly News webpage.

In the absence of this final quarterly report, those wishing to scrutinise the process in some detail have been denied crucial information on the nature and level of robustness of the processes employed in the critical closing stages of the GDA.

COARS AND AFS – REDACTION AND LACK OF TRANSPARENCY

This Review considers the redaction and other forms of lack of transparency in the GDA documents that are publicly available.

A number of the COARs include sections of redacted text. Whereas it is accepted that there is some justification for redacting text and diagrams, etc., relating to proprietary and/or security matters, there are areas of redaction that obviously relay information on the consequences of accidents, the risk of accidents and/or variations of accidents but it is not clear, because the detail is not available, whether these variations are within the design basis of the established and evaluated accident scenarios. One example of this is where the potential (radio)iodine available for release to off-site, and the risk (frequency of occurrence) of a fuel core meltdown accident are redacted, even though this information would be invaluable to the local authority in carrying out its responsibilities under the *Radiation (Emergency Planning and Public Information) Regulations 2001*.

This Review also briefly examines other forms of lack of transparency in the COARs and other published documents of the GDA. These include the often excruciating use of jargon, such as *'the GDA followed a step-wise-approach in a claims-argument-evidence hierarchy'*, and the citing of and reliance upon reference documents that the ONR refused to make publicly available when requested under the *Freedom of Information Act* and *Environmental Information Regulations* - all of which is quite contrary to the Health and Safety Executive's promise of 2008, when setting out the objectives of the GDA, promise to *'. . introduce high standards of openness and transparency to the GDA process'* and is counter to HSE's much trumpeted policy of *'the presumption of disclosure'* and its putative commitment to *'openness and transparency'*.

IN CONCLUSION

It was beyond the scope of this Review to assess the technical and engineered basis of the ONR's decision to grant the *Final Design Acceptance Compliance* (F-DAC) for the EPR nuclear plant, Instead, the Review has examined the structure of the GDA process, concentrating on the final phase during which the outstanding GDA Issues identified by the Step 4 process have been *'settled'*.

The conclusion is that certain of the GDA Issues have, in fact, **not** been settled but deferred via *Assessment Findings* for later resolution at various times during the construction and, possibly, commissioning phases of the plant. Where specific plant design issues have been examined in some detail (in this Final and by the two previous Interim stages of this Review), the finding has been that the design, development and testing of specific hardware systems (the NCSS) and the demonstration of nuclear safety (the SBO Sequence safety case) all remain incomplete.

This Review does not form an opinion on the safety of operation of the EPR plant proposed for the Hinkley Point C and Sizewell C new nuclear build sites. Instead, it has considered whether the *Generic Design Assessment* has demonstrated, so far as is reasonably practicable, that such a future EPR nuclear plant will operate at acceptable risk and tolerable consequences of radiological impact on the environment and members of public.

The Review concludes that particularly in this demonstration the GDA is incomplete.

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FINAL REVIEW ON THE GENERIC DESIGN ASSESSMENT OF THE PROPOSED GENERATION III NUCLEAR POWER PLANTS FOR THE UNITED KINGDOM'S NEW-BUILD NUCLEAR PROGRAMME

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22 MAY 2013	R3206-I3-24-05-13-R33		6 JUNE 2013

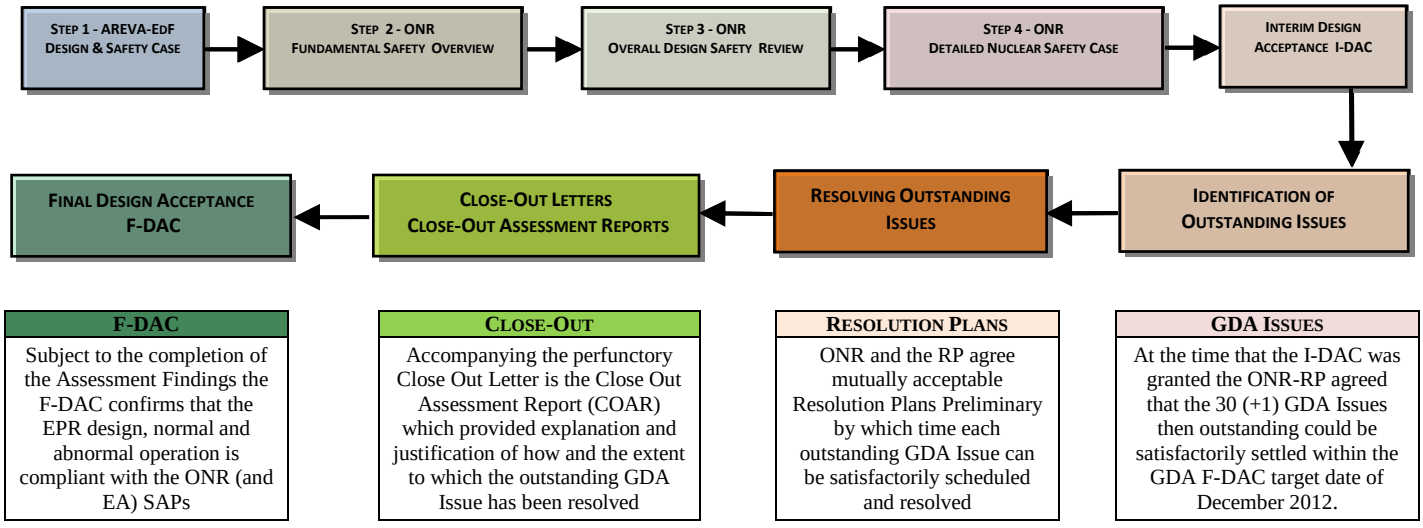
GENERIC DESIGN ASSESSMENT OF THE PROPOSED GENERATION III NUCLEAR POWER PLANTS

GDA PROCESS

The Generic Design Assessment (GDA),[1] also referred to as *pre-licensing*, aims to assess the generic safety, security and environmental aspects of new designs of nuclear power plants (NPPs). Underway since early 2008, the GDA originally considered four different Generation III NPP designs but, apart from the AREVA European Pressurized Reactor (EPR),[2] all other Generation III PWR designs, notably the Westinghouse AP1000, were suspended or completely withdrawn from the GDA process, although the advanced Boiling Water Reactor (ABWR) recommenced a separate GDA evaluation on or about 15 January 2013.[3]

The GDA is the Office for Nuclear Regulation's (ONR) assessment of the nuclear safety case[4] for a generic design of nuclear plant comprising the following four sequential elements, culminating in the issue of a conditional *Interim-Design Acceptance Compliance* (I-DAC). Thereafter, any issues that have not been resolved at Step 4 are *identified* and *resolved*, being *closed-out* before the F-DAC is granted:

SCHEMATIC 1 GDA HEAD-TO-TAIL PROGRESSION



OUTSTANDING GDA ISSUES

The outstanding GDA Issues are matters that cannot be immediately resolved at closure of the Stage 4 process but which, it is assessed at that time, can be *'closed-out'* within the scheduled timetable for granting of the F-DAC. Such was the confidence and general consensus between the regulator and the Requesting Party (RP - for the EPR being AREVA-EdF) was that it would be possible to resolve each outstanding GDA Issue within a mutually agreed timescale (as set out in the *Resolution Plans*). On this basis, the ONR granted the *Interim Design Acceptance Compliance*

1 For further background information on the GDA process see 1st Interim Review

2 The EPR is a four-loop PWR (Pressurized Water Reactor) with electric output of 1,600 MWe and thermal power of 4,300 MWt - the reactor operating pressure is 155 bar.

3 The ABWR is the Hitachi-GE design and was recently (January 2013) nominated by *Horizon Nuclear Power* for proposed NNPs at Wylfa and Oldbury - ONR-EA announced the GDA of the Hitachi-GE Advanced Boiling Water Reactor in April 2013 and the first submission is expected in Autumn 2013.

4 The GDA is the first phase of a two-phase process where the 2nd phase relates to nuclear site licensing being site and operator specific.

(I-DAC) in December 2011 with the intent that outstanding issues at that time could be resolved by the target date for the granting of the F-DAC.

At the time of the Large & Associates 1st Interim Review (June 2012) there were 30 outstanding Generic Design Assessment (GDA) Issues at the end of January-March 2012 reporting quarter relating to unresolved concerns across a number of sectors of the pre-construction nuclear safety case (PCSR) for the proposed EdF-AREVA European Pressurised Reactor (EPR) nuclear power plant (NNP) design. Each of these issues had to be resolved before the Office for Nuclear Regulation (ONR) could proceed to grant the *Final-Design Acceptance Compliance* (F-DAC), thereby superseding the I-DAC. In addition to and quite separate from the outstanding GDA Issues, the European Commission review of the Fukushima Daiichi accident of March 2011 required, on a pan-European front, each national regulator to assess the adequacy of existing and proposed nuclear power plants (NPPs) in responding to extreme external events. For the planned EPR NPPs at Hinkley Point and Sizewell, the ONR raised a *General Issue* under the GDA process which, for the EPR design, refers the requesting parties to the ONR Chief Inspector's Interim and Final Fukushima Reports of May and September 2011 respectively. With this extra GDA Issue the total GDA outstanding issues reached 31 in June 2012.[5]

In March 2012 one outstanding GDA Issue had been settled, three months later at the time of the Large & Associates 2nd Interim Review (September 2012) and at the close of the April-June 2012 reporting quarter, the ONR and the *Requesting Parties* (RP) AREVA-EdF had only settled just two further GDA Issues. Thereafter progress was such that another six issues were settled by late September, leaving the remaining 22 (+1) issues all to be settled during the month of November. Within this final group, 13 issues attracted a flurry of regulatory attention to be resolved just two weeks or so ahead of the granting of the F-DAC.

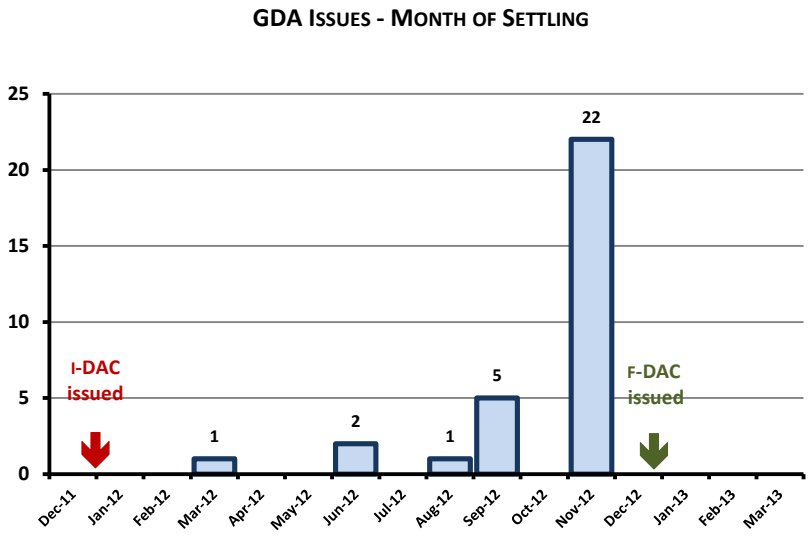


FIGURE 2 RATE OF SETTLING OUTSTANDING GDA ISSUES

CHART 1 of the 2nd Interim Review illustrated how much the original *Resolution Plan* timescales for one GDA Issue (GI-UKEPR-SI-02) had been modified, resulting in a time slippage in settling this particular Issue within the forecast 302 days, whereas actual close-out took 424 days to complete. At the time (June 2012) the ONR put this down to failure of the RP to keep abreast of the agreed document delivery schedule and revising this (see GRAPH 2 of 2nd Interim Review) reckoned that the remaining 28 outstanding GDA Issues could be dealt

5 In the UK, ONR was required to evaluate and report to European Nuclear Safety Regulators Group (ENSREG) for peer review, producing its *National Final Report* in December 2011. The ONR's National Report is a general compilation of the stress tests evaluations prepared by the individual operators (for UK NPPs EdF and the Nuclear Decommissioning Authority - NDA), although these NPP-specific evaluations have not been made publicly available. Whereas the European Commission required new NPPs under construction (but yet to be commissioned into generation service) to be subject to the Stress Tests, the ONR argued in its *National Progress Report* of September 2011 that *'As none of the three potential licensees are currently constructing a new NPP they are excluded from the UK national report on the stress tests'*.

with and closed-out by the end of 2012, although the ONR acknowledged that this would be a *"considerable challenge"*. In fact, the post-June 2012 revised document schedules, along with many of the revised Resolution Plans, seem to have been abandoned because the bulk of the GDA Issues apparently being somewhat hurriedly completed just a few weeks before the issue of the F-DAC – see FIGURE 1.

The 1st Interim Review illustrated a means by which certain areas of incompleteness could be leapfrogged beyond the F-DAC target date for resolution at some specified point in the Phase 2 NPP construction or during manufacturing and procurement phases of supply lines for components, systems, etc. This opportunity to manipulate the assumedly more detailed aspects of the GDA is referred as the somewhat oddly worded *Assessment Finding* (AF).

TABLE 1[6] collates the dates (*Col 5*) that the AFs were made public with inclusion in the *Close-Out Assessment Report* (COAR) dealing with each particular outstanding GDA Issue. The bulk (the remaining 22 out of 31) of the outstanding GDA Issues was resolved in November 2012 with the publication of the perfunctory *Close-Out Letter*, whereas with a few exceptions, the COARs, revealing the numbers and details of the AFs for each particular GDA Issue, were not publicly available until three to four months later in March 2013.

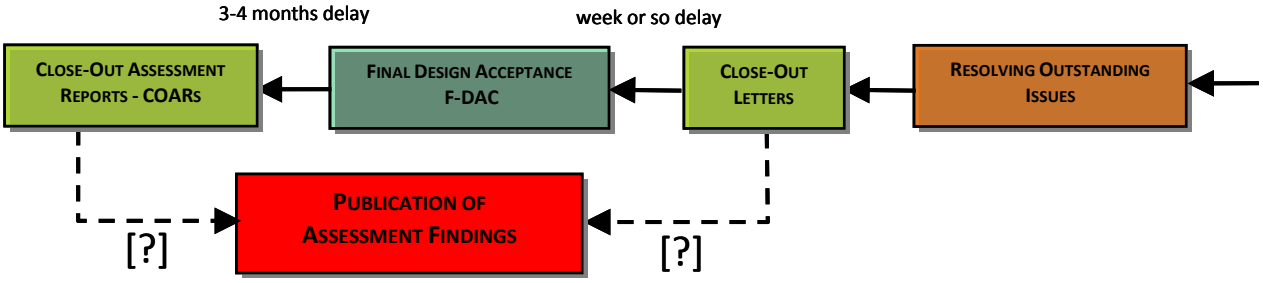
In effect, the delayed COARs rearrange the decision and justification sequencing phase of the head-to-tail GDA evaluation process shown previously in SCHEMATIC 1. However, with the *Close-Out Letter* being published well ahead of completion and publication of the *Close-Out Assessment Report* (COAR), the conundrum here is whether all, some or none of the subsequently raised 240 separate AFs were established in sufficient detail for the Close-Out Letters to be issued and, as a whole, the F-DAC granted in mid-December 2012.[7]

GDA REF	ISSUE CLOSE-OUT	WORK DAYS	Nº AFS	ASS REPORT DATE	COMMENTS
CATEGORISATION & CLASSIFICATION					
CC-01	29-Nov-12	253	10	Mar-13	
CC-02	30-Nov-12	254	4	Jan-13	
CC-03	13-Nov-12	241	7	Mar-13	
			21		
BEYOND DESIGN BASIS					
CE-01	02-Nov-12	234	2	Jan-13	
CE-02	29-Nov-12	253	8	Feb-13	
CE-03	28-Sep-12	209	3	Jan-13	CE-04 duplicate
CE-04	28-Sep-12	209	3	Jan-13	
CE-05	28-Mar-12	77	2	May-12	
CE-06	09-Aug-12	173	2	Dec-12	
			17		
CONTROL & INSTRUMENTATION					
CI-01	29-Nov-12	253	53	Mar-13	
CI-02	28-Sep-12	209	53	Mar-13	CI-01 duplicate
CI-03	13-Nov-12	241	53	Mar-13	CI-01 duplicate
CI-04	13-Nov-12	241	53	Mar-13	CI-01 duplicate
CI-05	13-Nov-12	241	53	Mar-13	CI-01 duplicate
CI-06	30-Nov-12	254	53	Mar-13	CI-01 duplicate
			53		
CLAIMS & ARGUMENTS					
EE-01	29-Nov-12	253	11	Feb-13	
			11		
FAULT STUDIES					
FS-01	02-Nov-12	234	11	Mar-13	
FS-02	29-Nov-12	253	36	Mar-13	
FS-03	30-Nov-12	254	9	Mar-13	
FS-04	29-Nov-12	253	4	Mar-13	
FS-05	30-Nov-12	254	31	Mar-13	
			91		
HUMAN FACTORS					
HF-01	30-Nov-12	254	6	Mar-13	
			6		
INTERNAL HAZARDS					
IH-01	28-Sep-12	209	1	Dec-12	
IH-02	02-Nov-12	234	4	Dec-12	
IH-03	02-Nov-12	234	3	Jan-13	
IH-04	28-Sep-12	209	1	Mar-13	
			9		
REACTOR CONTAINMENT					
RC-01	13-Nov-12	241	4	Jan-13	
RC-02	29-Nov-12	253	1	Jan-13	Close-Out date
			5		
RADIOLOGICAL PROTECTION					
RP-01	19-Jun-12	136	1	Dec-12	
			1		
STRUCTURAL INTEGRITY					
S1-02	29-Jun-12	144	1	Sep-12	
SI-01	13-Nov-12	241	25	Feb-13	
			26		
Total AFs raised in COARs			240		

TABLE 1 ISSUES AND ASSESSMENT FINDINGS

6 Table 1 is extracted from the HSE web page *http://www.hse.gov.uk/newreactors/gda-issue-close-out-uk-epr.htm#close-out-reports* – apparent missing links and duplicated reports are highlighted in the shaded cells and these have not been corrected to date and may therefore introduce some error in the statistics presented here.

7 *Design Acceptance Confirmation for the UK EPR™ Reactor*, ONR 13 December 2012



SCHEMATIC 2 REVISED GDA PROCESS

This *'chicken-before-the egg'* poser (SCHEMATIC 2) cannot be resolved with the present level and detail of information accessible in the public domain.

NUMBER OF AFS RAISED IN COARS

Both TABLE 1 and FIGURE 2 reveal the high numbers of AFs raised for certain outstanding GDA Issues in the COARs. The 240 AFs totalled in TABLE 1 are in addition to those AFs raised in the Step 4 phase of the GDA process that completed in or around December 2011 at the granting of the I-DAC. These Step 4 AFs are not considered further here, other than to note that the entire GDA process up to December 2011 (about 3 years) raised 484 AFs[8] compared to the further 240 AFs raised in settling the 31 outstanding GDA Issues over the one year period between the granting of the I-DAC and F-DAC.

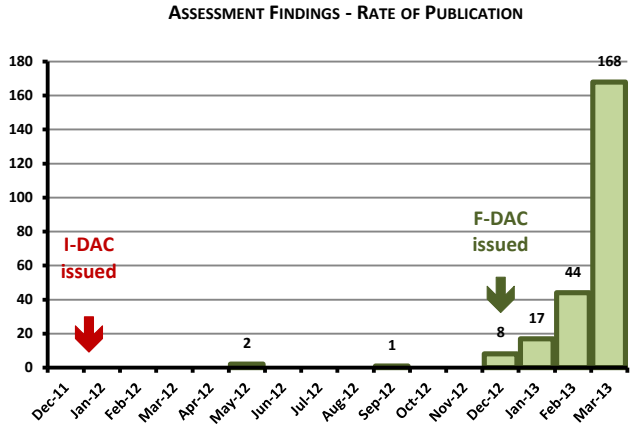


FIGURE 2 ASSESSMENT FINDINGS BY PUBLICATION DATE

In the COARs dealing with the outstanding GDA Issues, the six separate *Control and Instrumentation Issues* (CI) raised a total of 53 AFs identified in the single COAR that ONR states covers all CI issues[9] and, similarly, across the five *Fault Studies* COARs 91 AFs were raised to be settled at some later points in the procurement and construction programme of the first EPRs at Hinkley Point C. The dominance of *Fault Studies* and *Instrumentation & Control* AFs is illustrated graphically by FIGURE 3.

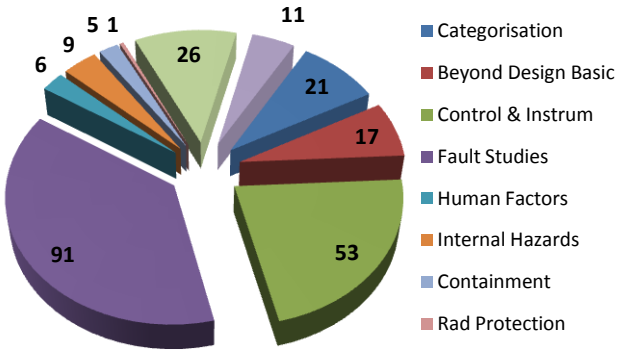


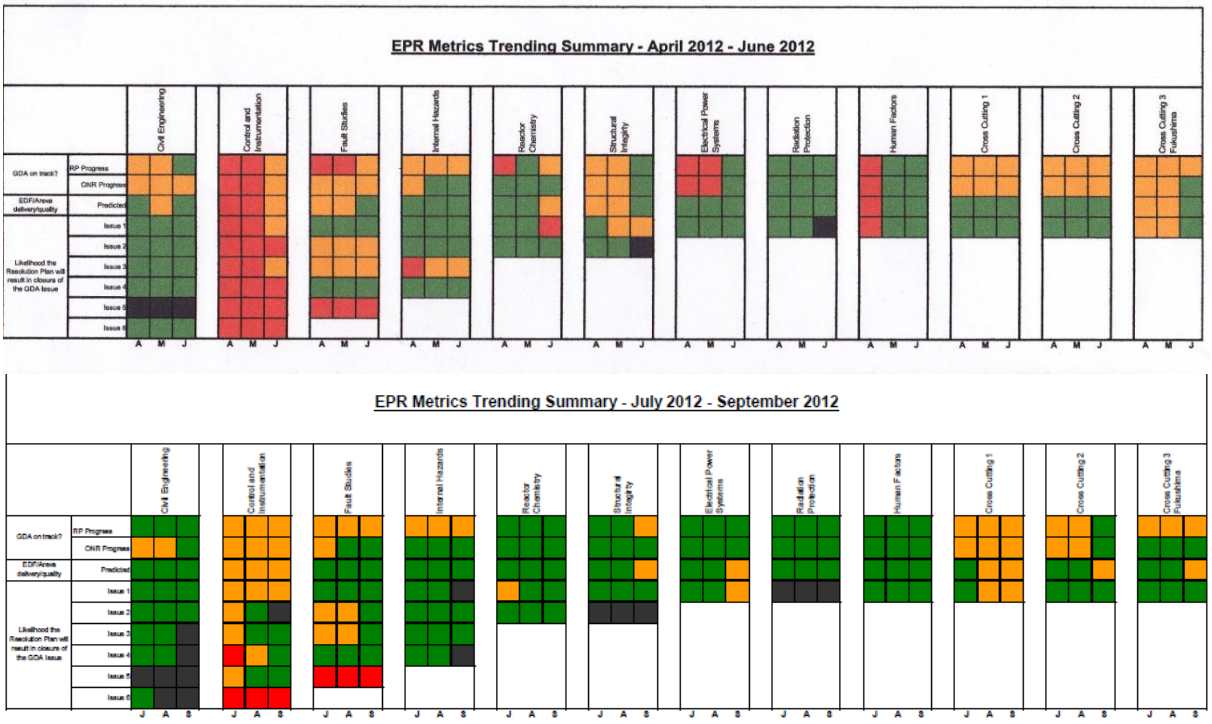
FIGURE 3 NUMBERS OF ASSESSMENT FINDINGS BY TOPIC

8 The total number of AFs raised by the Step 4 Reports is given as 484 in *Summary of the detailed design assessment of the Electricité de France SA and AREVA NP SAS UK EPRTM nuclear reactor (Step 4 of the Generic Design Assessment process)* 14 December 2011. The AFs raised in each topic area are to be found published as the individual issue closure reports were placed on the internet – see GDA Close-out for the EDF and AREVA UK EPR™ Reactor GDA Issue GI-UKEPR-CE-06 Rev 1 – *Seismic Analysis Methodology for the Design of the UK EPR*, December 2012.

9 ONR to Large & Associates, e-mail, 21 May 2013

CORRELATING THE COAR'S AFS TO THE METRICS DASHBOARD

ONR's assessment of progress for the Q2 and Q3 2012 quarters (below) indicates that at the end of June 2012 (Q2) sections of the CI and FS were then at high risk of substantial delay, as identified thus ■ by the ONR metrics dashboard (2nd Interim Review). By the close of the third quarter (Q3) the assessment indicates for both CI and FS issues that *'significant, prompt action'* was required in the areas marked thus ■, and that for two CI and one FS issue that the *'delays cannot be recovered'* being marked thus ■.



Although the correlation is not exact, it is interesting to note that, generally, the two outstanding GDA Issues identified by the above dashboards to be of greatest concern of failure to complete on time to the F-DAC target date of December 2012, raised a greater number of AFs – ie Fault Studies (FS) and Control & Instrumentation (CI), both at high risk of delay each raised a larger number of AFs than the other outstanding GDA Issues.

PURPOSE AND APPLICATION OF THE ASSESSMENT FINDINGS (AFS)

ONR's justification of the AF provision is that although the AFs are *'important safety items'* they are not considered '*critical to the decisions to start nuclear island construction'* and that the '*expectation is that they will be addressed during Phase 2 site specific projects'*.[10] ONR also notes that the GDA process was *'not intended to provide a complete assessment of the final reactor*

10 The AFs are defined by the ONR in *New Nuclear Power Stations Generic Design Assessment, Guidance in the Management of GDA Outcomes, (including the scope of GDA, Provision of HSE Design Acceptance Confirmations and Environment Agency Statements of Design Acceptability, and the resolution of Issues and assessment findings raised during GDA*), June 2010 viz *"Other issues / findings identified during the regulators' GDA assessment, but not considered critical to the decision to start nuclear island safety-related construction of such a reactor. The findings will be included in HSE's GDA Step 4 Reports or the Environment Agency's GDA Decision Document. They will need to be addressed, as normal regulatory business, either by the designer or by a future Operator/Licensee, as appropriate, during the design, procurement, construction or commissioning phase of the new build project"*.

design, as there will be other issues, operator specific or site specific, that we would expect to be considered during the environmental permitting and site licensing stages'.[10] The ONR also state[11]

> *". . . Assessment Findings are mostly matters that we would anyway have raised during our site specific assessments. By identifying them during the GDA process we are maximising the time available for future licensees and operators of the UK EPR™ reactor to address them. Early identification of Assessment Findings in this way thus represents one of the key benefits of the GDA process. . ."*

This definition strongly infers that the AFs are to facilitate settling of site- and operator-specific issues and therefore should not include generic design issues otherwise, it follows, the GDA would be incomplete and the F-DAC could not be granted.

It is beyond the scope of this Review to scrutinise all 240 AFs raised during the outstanding GDA Issues phase, although it is worthwhile scanning through a sample of the FS and CI AFs to determine if properly the AFs only apply to operator- and/or site-specific issues and are not of a generic design nature – for brevity, just one example from the FS AFs, and with a general observation on C1 AFs, will be discussed here.

FAULT STUDIES – FS-02: Assessment Finding AF-UKEPR-FS-46 requires the RP to *'provide a fully integrated safety case for the station blackout sequence'* in place by the time of the delivery of the mechanical, electrical and C&I safety systems to the site.

The station blackout (SBO) event is where on- and off-site electricity supplies are lost and, as a result, the nuclear fuel core is at risk of overheating and melting. Essentially, this was the adverse event scenario[12] that took place at the Fukushima Daiichi NPP in March of 2011 resulting in the meltdown of three operating reactor fuel cores that had been successfully shut down in response to seismic loading by the earthquake, but which subsequently lost on-site power when the emergency generators providing power for dissipating the post shutdown fuel core decay heat were swamped by the tsunami.

The outstanding GDA Issue item related to a combination of faults culminating in a loss of off-site power (LOOP), together with failure of the emergency diesel generators (EDG) and, importantly, that management of this fault condition was dependent upon operator intervention. Given the timescales involved for operator action and the serious radiological consequences should the operator fail to perform the required actions, the close-out of this AF requires the design to incorporate fully automatic starting of the ultimate diesel generator (UDG) and, in addition, it was noted that the LOOP-EDG scenario was not considered in the review of functional diversity for frequent faults.

Obviously the SBO situation arising from LOOP-EDG failures in neither operator- or site-specific, qualifying as a *generic* issue and, hence, it may have been inappropriate to defer this topic to an AF settlement at a relatively late or *'no-turning-back'* stage in the equipment procurement process. Indeed, the ONR concludes:[13]

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11 *New nuclear reactors: Generic Design Assessment Electricité de France SA and AREVA NP SAS UK EPR™ nuclear reactor Summary of the GDA Issue close-out assessment of the Electricité de France SA and AREVA NP SAS UK EPR™ nuclear reactor*, ONR, 12 December 2012.

12 *A Brief Opinion on the Incidents, Developing Situation and Possible Eventual Outcome at the Fukushima Daiichi Nuclear Power Plants*, Interim Report, R3196-A, April 2011

13 *GI-UKEOR-FS-02-Close Out* (¶122).

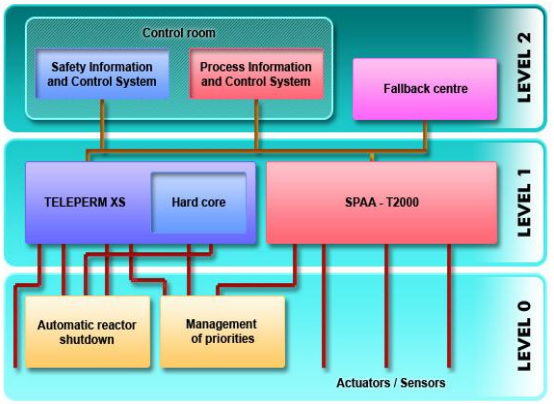
> *". . . In conclusion, it can be seen that there is a significant amount of work still to be done to fully substantiate the safety case for the station blackout sequence. . . . This will need to substantiate the claims on operator reliability, review the implications of prioritising UDG start-up over local to plant start-up of the EDGs, substantiate the timescales predicted from transient analysis studies, the structural integrity claims covering thermal shock following restart of feed to empty SGs, and the structural integrity and reliability claims on the stand-still seal system due to thermal and mechanical loads they experience during the fault sequence. . ."*
>
> my abridgement . . .

That said, the ONR adds

> ". . . *Nevertheless, on the basis of the information presented, I am content that sufficient progress has been made for the purposes of GDA to justify the closure of Action 8 of GDA issue GI-UKEPR-FS-02. . ."*

CONTROL AND INSTRUMENTATION - CI-01 TO 06: The C&I architecture adopted for the EPR was first proposed in 2005. Essentially, this centralised control and instrumentation digital system serves to monitor, report on and automatically control a number of key safety roles.[14]

There are three main levels of partition: *Level 0* interprets digitised information received from sensors and, similar, generates commands to actuators; *Level 1* manages the automation functions, including reactivity, turbo-generator load and the associated protection systems, as well as a myriad of other local controlling and protection functions; and *Level 2* works in the human-machine interface that allow the nuclear and steamside plants to be operated and monitored. There are two associated and interlinked computer platforms: the TELEPERM XS (TXS) dedicated to reactor protection in incident and accident situations; and the SPPA-T2000 which primarily manages functions linked to normal plant operation but which, for certain reactor protection, also acts in incident and accident situations.



SCHEMATIC 3 EPR C&I LEVELS
after ASN

Following some difficulties with the lead EPR project at Olkiluoto, Finland, in October 2009 the French nuclear regulator *Autorité de sûreté nucléaire* (ASN) expressed concerns over the high interconnectivity and lack of separation between the TXS and SPPA platforms in the two functional areas (incident protection and operation control) and, particularly, the safety conformity of the SPPA-T2000 platform. ASN then required EdF-AREVA to provide additional justification for its use at the EPR FLA3 project then underway at Flamanville, France. Such was the concern with the EPR C&I system, in November 2009 ASN, together with ONR and the Finnish nuclear safety regulator *Säteilyturvakeskus* (STUK), issued a joint position statement on the design of the EPR C&I systems:

14 For an explanation of the EPR C&I system fundamentals see *The UK EPR Digital I&C System*, Nuclear Engineering International, 15 April 2013.

> "*. . . 2. . . . we have all raised issues regarding the EPR Control and Instrumentation (C&I) systems, which the proposed licensees and/or the manufacturer (AREVA) are in the process of addressing.*
>
> . . .
>
> *4. The issue is primarily around ensuring the adequacy of the safety systems (those used to maintain control of the plant if it goes outside normal conditions), and their independence from the control systems (those used to operate the plant under normal conditions).*
>
> *5. Independence is important because, if a safety system provides protection against the failure of a control system, then they should not fail together. The EPR design . . . doesn't comply with the independence principle, as there is a very high degree of complex interconnectivity between the control and safety systems.*
>
> *6. . . . [the regulators] have asked the licensee and manufacturer to make improvements to the initial EPR design. The licensees, and AREVA, have agreed to make architectural changes to the initial EPR design which will be reviewed by the regulators.*
>
> *7. . . . as designs are similar, it is likely that the solution will be similar, although not necessarily identical, taking into account individual licensees' requirements and national regulatory requirements or practises. As an example, in providing defence-in-depth, different solutions could be proposed to back-up safety systems. In all cases, however, the solutions will lead to equivalent high levels of safety. . .*"
>
> my abridgement . . . and added *[explanation]*

AREVA's solution was to separately develop what it refers to as a *'hard core'* (CCND) within the TXS platform that is capable of dealing with a total loss of the SPPA-T2000 platform. The CCND system effectively provides a bypass around the two platforms in case of failure of either or both because, so it is claimed, it is a non-computerised, basic electronics system which is sufficiently diverse to be invulnerable to a common mode failure with either or both TXS and SPPA platforms. In the event of loss of the main TX and/or SPPA platform, the CCND is required to manage a limited number of reactor safety functions during an incident/accident situation. In April 2012 ASN, following the recommendations of the *Groupe Permanent D'experts Pour Les Reacteurs Nucleaires*,[15] other than then requiring guarantees on the continuity and in service testing, ASN generally found the CCND and the EPR C&I system satisfactory.[16]

On its part, the ONR refers to the CCND as the *non-computerised safety system* (NCSS) and it relies heavily on the incorporation of NCSS in the EPR safety case to close-out the C&I outstanding GDA Issues. That said, ONR notes *'. . . it has not been possible to perform an assessment of the high level design of this [NCSS] system as insufficient information has been made available within the timeframe of this [GDA] review'* (COAR - ¶161).[17]

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15 *Avis - relatif à l'architecture du contrôle commande du réacteur EPR Flamanville 3 et aux plates-formes associées*, Groupe Permanent D'experts Pour Les Reacteurs Nucleaires, 16 June 2011.

16 *Nuclear Pressurized Water Reactors – Flamanville 3 EPR Project Architecture of the I&C system and associated platforms*, ASN, CODEP-DCN-2011-052544, 4 April 2012.

17 COAR - *GDA Step 4 and Close-out for Control and Instrumentation Assessment of the EDF and AREVA UK EPR™ Reactor*, ONR-GDA-AR-11-022, March 2013

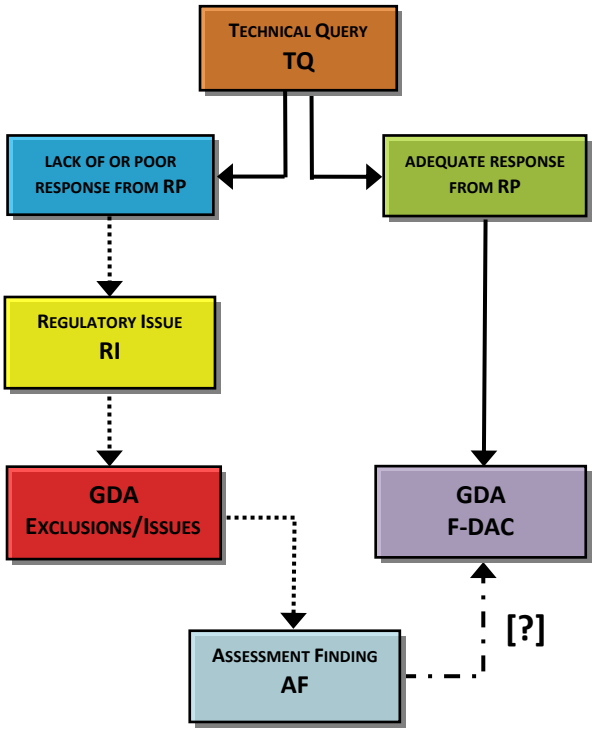
In fact, failure of EdF-AREVA to provide sufficient information to the ONR and its technical support contractors (TSC) to enable assessment of aspects of the NCSS is cited throughout the COAR,[17] for example including lack of information, etc., on automatic functions (¶240), priority actuation control system (¶247), function allocation (¶276), diversity with TXS/SPPA (¶277-¶287-¶430-¶439), reliability data (¶310), and incomplete design (¶403-¶425-¶427).

The NCSS *hard core* system is an addition to the two C&I platforms that monitor and manage normal operation and incident/accident response – for the EPR, the NCSS is unique, it is a *bolt-on* system added at the behest of ASN late in the EPR development programme, it is the first instance of integrating such a back-up system into the complex, centralised dual C&I approach and, clearly, its design and proving are incomplete.

The ONR acknowledges that crucial safety aspects, and hence the nuclear safety case, of the EPR C&I cannot completed *'. . until the first [combined] system has been tested in the factory, when all the evidence that can be assembled demonstrates the system meets its requirements'*.[17] Obviously, the design and development of NCSS and overall C&I system[18] is incomplete, at least to the extent that EdF-AREVA were unable to provide the ONR with information and data for its generic assessment.

CONCLUDING THE GDA PROCESS

Whether by intent or not, the practice of deferring settlement of outstanding GDA Issues by raising AFs, as illustrated by the two examples (SBO sequence and C&I NCSS), seems to be a continuance and compounding of previously raised *Technical Queries* (TQs). Throughout the GDA process the RP's progress in responding to TQs has introduced significant delays (see 1st and 2nd Interim Reviews) which resulted in considerable revision of the Resolution Plans of the outstanding GDA Issues at a late stage in the overall GDA process. Indeed, it may have been that the delays and shortfalls of the information submitted by the RPs could have elevated the TQs into the more serious *Regulatory Issues* (RI) which, in turn, could have led to safety topic areas (such as the SBO and NCSS) being excluded from the F-DAC confirmation via the administrative use of what were previously (prior to June 2010) referred to as *Exclusions*,[19,20] but which now seems to have been replaced in the ONR GDA lexicon with *GDA Issues*.[10]



SCHEMATIC 4 GDA EXCLUSION

18 Here this Review has focussed on the NSCC topic. There are a number of other concerns with the centralised C&I system, including, for example, that all of the GDA submitted documentation up to Stage 4 was based on the then redundant Siemens SPPA-2000 S5 Mk platform whereas the S7 Mk is planned for installation in the UK; to date there had been little statistical testing to determine the probability of failure on demand (pfd); that the inclusion of *smart* devices (transducers with various degrees of autonomy typically embedded within a larger piece of equipment) had not been justified.

19 Exclusions – generic issues that the ONR judges remain unresolved – see *Generic Design Assessment What is it and where are we??*, Watson D, NGO Seminar June 2009.

20 The stated intention of the ONR was there *'there should be as few exclusions as possible'* and although there is reference to *'Exclusion Guidance being Developed'* (2009) but there is no specific documentation publicly available on this.

Instead of the unresolved SBO and NCSS TQs following the route to being an unresolved GDA Issue (lh side of SCHEMATIC 4) because clearly the RP response was inadequate, the ONR has instead raised AFs thus permitting granting of the F-DAC ahead of settling the outstanding AFs (mid and rh side of SCHEMATIC 4).

This AF deferral approach highlights three areas of concern:

1) the raising of so many AFs, particularly in the FS and C&I Issues, strongly suggests that the EPR design is presently incomplete and, indeed, may have stepped back in several respects since the GDA commenced[21] - with the EPR design being incomplete, or in a 'fluid' state, and the greater the shortfall in the content and clarity of the information submitted by the RP, then the more difficult the ONR GDA assessment becomes;

2) should issues such as the SBO and NCSS, which are absolutely fundamental to nuclear safety, be administered via AF deferral or should such be considered as Regulatory Issues leading to possible exclusion from the F-DAC earlier in the GDA process[22] - the distinction between an AF and RI is that for the latter the issue is considered of sufficient importance that it would, if unresolved, *'prevent progression to the next step of the Generic Design Assessment'*[23] thereby triggering an unresolved GDA Issue; and

3) there seems, from the documents publicly available, that no administrative mechanism exists by which a *settled* AF (that might include for substantial revisions to the EPR plant design or operating procedure, etc.,) can be incorporated into the GDA F-DAC – this is because the AFs are defined to be site- and/or operator-specific, although the SBO and NCSS examples examined in this Review are clearly generic issues - and, similarly, there seems to be no mechanism by which an *unsettled* AF is to be incorporated into the GDA as some form of exclusion or halt to the GDA process – put simply, the AFs allow the RP another, second or third bite of the cherry.

The second area concern (2) seems to contravene the ONR's guidance[10] on the GDA process administration. This states that unresolved GDA Issues *'would need to be cleared before a Final HSE DAC . . . could be provided . . . and that all of the Issues referenced in the Interim DAC . . . were amenable to timely resolution'*. For this *'timely resolution'* a Resolution Plan has to be agreed so that both parties, the RP and ONR but, importantly, the overriding assumption is that the unresolved or outstanding GDA Issue **will** be resolved given time and resources. Only once that all of the outstanding GDA Issues have been resolved can then the F-DAC be granted.

As discussed in the 2nd Interim Review, almost all of the outstanding GDA Issue Resolution Plans had to be amended. However, for the C&I NCSS evaluation the ONR could still not settle the NCSS topic (amongst others) because it was unable to assess the high level aspects of the NCSS system owing to its incomplete design, noting that the adequate functioning of the NCSS could only be at the time that the first NCSS system has been built and tested in the

21 The incompleteness of the EPR design and development may have arisen from the design and construction experience at the lead EPR plants of Olkiluoto and Flamanville; from safety issues raised by the runaway situation at Fukushima Daiichi in March 2011; and/or from an external supplier, here Siemens, rendering much of the central control and instrumentation system obsolete (ie the S5 SPPA platform).

22 The C&I architecture has already been subject to a Regulatory Issue - RI-UKEPR-002 – raised on the adequacy of the C&I platforms in April 2009 as part the Step 4 process – it was the response to this RI that introduced the NCSS system – the RI was closed in November 2010, although at that time a number of Technical Observations were awaiting response for the RP – see *Step 4 Control and Instrumentation Assessment of the EDF and AREVA UK EPR Reactor*, Assessment Report: ONR-GDA-AR-11-022, Revision 0, 11 November 2011.

23 For the application of a RI see RI-EPR-0001, raised letter of 1 February 2008.

factory.[17] In other words, the assumption at the time of the I-DAC that this particular unresolved GDA Issue could be resolved given time and resources was **mistaken** and this GDA Issue remains unresolved after the F-DAC has been granted.

The GDA guidance on this is quite clear, being (p7, ¶17.c)[10]

> *". . . c) If the regulators are not content with safety, security . . . of the safety case for the generic design, then no Design Acceptance Confirmation (DAC) . . . will be issued. This would be the case where regulators judge that there is a significant, unacceptable shortfall in the design or safety submissions. It would be a matter for the RP to decide whether to propose additional work to address the shortfalls, which may allow a Final or Interim Design Acceptance Confirmation . . . to be provided at some future date. . ."*
>
> my truncation . . .

Since the ONR has granted the F-DAC then this is an expression of its confidence that the EPR can be built and operated in a safe and secure manner – for both the SBO and NCSS this confidence is subject to caveats in the fulfilment of certain Assessment Findings. Again referring to the GDA guidance (p11, Glossary):[10]

". . .

Other GDA assessment findings	*Other issues / findings identified during the regulators' GDA assessment, but not considered critical to the decision to start nuclear island safety-related construction of such a reactor. The findings will be included in HSE's GDA Step 4 Reports or the Environment Agency's GDA Decision Document. They will need to be addressed, as normal regulatory business, either by the designer or by a future Operator/Licensee, as appropriate, during the design, procurement, construction or commissioning phase of the new build project*

. . ."

The point here is whether the AFs issued in connection with the SBO and NCSS issues (amongst others) are *'not considered critical to the decision to start nuclear island safety-related construction of such a reactor'.* It is difficult to reason why both SBO and NCSS would not be critical to the nuclear island safety related works and, in this respect, how ONR was able to arrive at its conclusion that the settlement of both of these unresolved issues (amongst others) could not possibly infringe upon and quite possibly require changes to the design of the nuclear island safety related construction.

After all, at the time of the granting of the I-DAC (December 2011) the ONR was confident that the outstanding C&I GDA Issue could be settled in time for the F-DAC twelve months later but, in substantive areas relating to the NCSS, it was not. The issuing of the AF deferral after the granting of the F-DAC is simply repeating this pattern – there does not seem to have been that much progress with development the NCSS system and its integration into (and diversification from) the TXS and SPPA platforms, so what is to guarantee that the NCSS AFs will be satisfied at some future date when the EPR plant Phase 2 construction has reached a point where the C&I system has to be installed?

QUARTERLY PROGRESS REPORTS

Q3 Quarterly Progress Report: The 3rd 2012 Quarterly Progress Report covering the period July through to September 2012 was published on or about 14 November 2012.

In referring to the adequacy of the nuclear island containment structure (the primary containment) - G1-UKEPR-CE-04 - ONR had to rely upon information and data provided by the RP that related to the reference design of the Flamanville 3 EPR plant[24] presently under construction, although extensively over-budget and behind schedule. A complexity here, correctly identified by ONR, is that Flamanville is a *'hard'* ground site which will be characterised by a different seismic response assumed for the two relatively 'soft' ground sites for the UK's venture into EPR plants at Hinkley Point and Sizewell. In the Flamanville design and modelling data sets ONR noted difficulties in differentiating between those factors that are generic and those that are site specific to the seismic response. For this case, ONR raised AFs AF-UKEPR-CE-73 and 74 that require site-specific factors to be taken into account prior to placement of the reinforced concrete groundworks at any UK EPR site.

The point here is not that ONR was unaware of the need to tailor the seismic design to UK sites, but that the public generally, and the Infrastructure Planning Inspectorate (IPC) in detail, would not have had knowledge of the need to develop the site-specific seismic design for the Hinkley Point C EPR development because the AFs were not publicly available until late January 2013, that is after the ONR issued the Nuclear Site Licence on 26 November 2012.[25]

Similar reservations apply to the Secretary of State's Order of 19 March 2013 which, amongst other factors, considered safety issues as cited by the Austrian Government under the Espoo Convention and the Environmental Impact Assessment Directive.[26] In the Decision Letter[27] the Secretary of State referred to the fact that the Austrian Government had, in fact drawn heavily upon documents published by the ONR's GDA process, although at that time because the COARs and AFs raised therein were not available, the knowledge basis of the Austrian objection could only have been incomplete.

Q4 Quarterly Progress Report: Although the GDA process continued until the granting of the F-DAC in December 2012 and included the closing out of 22 of the total 31 outstanding GDA Issues, a quarterly progress report for this period (October-December 2012) has not be made publicly available to date. Instead, the ONR considers[28] that the information posted on *ONR Quarterly News* webpage to be sufficient, although very succinct:

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24 Interestingly, no reference seems to have been made to the Olkiluoto EPR (OL3) in Finland which is more advanced in its construction than that at Flamanville, although it also has been and continues to be beleaguered with delays and cost overruns.

25 In fact the IPC notes that it could not consider in its initial assessment topics such as nuclear safety and it specifically refers parties concerned about nuclear safety directly to the ONR in its report and recommendations to the Secretary of State of 19 December 2012 *"4.7 In making their representations, many parties raised concerns regarding nuclear safety matters that are within the remit of other regulators, or concerns regarding matters of Government policy on nuclear energy. As set out in Chapter 1 of this report (see paras 1.5 and 1.6) where the opportunity arose, we advised those making such representations of the limits of our remit and suggested that they may wish to address their concerns elsewhere (such as to the Office for Nuclear Regulation (ONR) or to Government through their elected representatives)".*

26 Environmental Impact Assessment Directive 2011/192/EU.

27 *Application for the Proposed Hinkley Point C (Nuclear Generating Station) Order*, Planning Act 2008, Secretary of State Department of Energy and Climate Change, 19 March 2013

28 ONR to Large & Associates e-mail – Lynne Hesketh, 24 May 2013

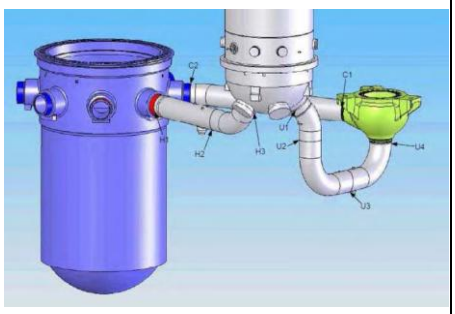
"*. . . All assessment reports for generic design assessment (GDA) 'issues' identified on the UK European Pressurised Water Reactor (UK EPR) have been published on the new reactors website. After a thorough assessment, ONR and the Environment Agency officially closed each issue, publishing confirmation letters on the new reactors website. Only once all 31 had been closed were we able to grant a Design Acceptance Confirmation and Statement of Design Acceptability in December 2012.*"

COARs and AFs – Redaction and Lack of Transparency

It is beyond the scope of this Final Review to evaluate in detail the individual COARs and AFs, although sampling these is of interest in the following respects:

Assessment Report Redaction: Text in about one-third of the COARs has been redacted, these are summarised as follows:

Table 2 Issues for which Assessment Reports have been Redacted

Issue	Report	Description of Redacted Items	Interest
Fuel Pond compartment handling and Loading	GI-UKEPR-FS-03 - this considers the spent fuel storage pond, particularly transfer of spent fuel to the various compartments of the pond	i) The probability of human failure rates (ie human error) and how these contribute to the probability of loss of pond cooling events, leading to the frequency of spent fuel damage (ie fission product release) when in the ponds. ii) Other redactions are mainly proprietary details and/or plant layout that might present a security risk.	i) Difficult to justify how human error and the overall risk of event is proprietary information and/or in the Public Interest not to disclose. ii) Redaction probably justified because mainly proprietary design information.
Control of Fuel Core Reactivity	GI-UKEPR-RC-02 - this relates to reactor coolant loop chemistry and the amounts of radioactivity present in the main reactor and linked ancillary systems.	Essentially, the assessment forecasts the levels of radioactivity in the primary and connected circuits – such as activated corrosion products, CRUD, fission products, most importantly (radio)iodine, and actinides in account of periodic fuel clad failure - much of the redaction relates to tabulated data forecasting the (radioactive) inventory for different conditions and periods of operation of the reactor plant	iii) Difficult to justify why it has been necessary to redact the reactor primary circuit inventory when this is required to map out the radiological risk in the event of a breach of the reactor plant and a bypassing of the primary containment – it might be argued that it is in the Public Interest to disclose such information.
Structural Integrity via Fracture	GI-UKEPR-SI-01-this considers the vulnerability of the structural integrity of critical pressurised Class 1 components and mechanisms of catastrophic failure via fracture mechanics.	Redactions are mainly proprietary design details, component (see below) thicknesses, etc., although the margin in the critical crack length has been redacted. 	iv) Redaction probably justified because mainly proprietary design information.
Combustible Gas Control	GI-UKEPR-RC-01- this examines the primary containment structure during and in the aftermath of accident conditions and, specifically, the containment	Sections considering the generation rates and quantities of hydrogen liberation into the primary containment during a SBLOCA (small break LOCA) and the time scales for the release are heavily redacted. Similarly data providing comparison between the different	v) This is an important Issue Assessment Report because, first, it provides a gauge of the risk of a breach of the primary containment or a bypass thereof and, second, the potential for relatively immediate radiological consequences in

	of combustible gases generated during the accident, such as hydrogen from and Zircaloy-steam reaction in a core melt.	modelling approached COCOSYS and GASFLOW and, particularly between GAFLOW and experimental results are redacted. Essentially this Issue considers the point at which the hydrogen formed in the fuel core via Zn-H_2O reaction will reach mix proportions that combustion (~5%) leading to detonation (>10%) will occur – an issue that remains largely unresolved and subject to Assessment Finding AF-UKEPR-RC-60 relating the role of the passive autocatalytic recombiner (PAR) is critical. The Assessment Report goes on to consider the amount of radioiodine released into the containment and which is at risk of release to off-site either directly via containment breach or via containment bypass. The Assessment Report is heavily redacted throughout.	the off-site domain via release and uptake of volatile iodine (I-131) – the I-131 source term (aerosol, elemental and organic) inside the containment is completely redacted as are the I-131 release to the environment (off-site). Radio-Iodine features strongly in the off-site radiological detriment potential in the immediate (24 hours) and intermediate term (36 to 72 hours) following an SBLOCA for which prophylactic and evacuation countermeasures have to be in place. So that the off-site detriment may be minimised it would be in the Public Interest to further review and disclose the redacted data. Included in this disclosure should be certain of the 13 Assessment Findings raised in this Issue Assessment Report.
Internal Hazards	GI-UKEPR-IH-02 – this considers internal hazards such as flooding, internally generated missiles, etc.	Most of the detailed redactions seem to relate to dimensions and locations of system that might pose a security risk – for example, how internal flooding is controlled and contained to one redundancy capable sector within a building or process, which valves are to be isolated or opened, ventilation system protection, cable runs, and so on	vi) Redaction probably justified because mainly security sensitive information, although that said, there appears to be some areas of heavy redaction that could describe the cascade or knock on consequences of an internal event on the overall nuclear safety case.
Internal Flooding	GI-UKEPR-IH-03 – similar to IH-02 above.	As for IH-02 above.	vii) As for IH-02 above.
Missile Generation from Reactor Circuit Components	GI-UKEPR-IH-04 – this assesses the predictions of damage and ensuing reactor scenarios following breakup and missile generation of the reactor circuit components.	Certain damage susceptible components are heavily redacted, for example the Nitrogen Tanks located in the reactor containment building – the redaction is extensive and detailed with, for example even the captions to the certain Figures being obliterated	viii) Some of the redaction is probably justified on proprietary design and/or security grounds, although other areas of redaction seem to refer to cascades or trains of events that could proliferate from missile generation and damage and these, since it bears on the overall nuclear safety case, might be justified in terms that disclosure would be in the Public Interest.
Dropped Loads	GI-UKEPR-IH-01 – similar to IH-04 above but for dropped loads.	As for IH-04 above.	ix) As for IH-04 above.
Seismic Analysis	GI-UKEPR-CE-06 – this deals with the approach to the seismic response analysis of the raft foundation and nuclear island civil engineered superstructures.	Seismic analysis for the EPR centred on computer software that adopted French standards whereas modifications are required to comply with UK requirements. It is the adaption from the hard soil base at Flamanville 3 to the relatively soft soil base presented at the UK sites of Hinkley Point and Sizewell. The single redaction in this Assessment Report is Figure 1 that should reveal the range of soils for the floor response spectra.	x) Because the redacted information relates to the overall nuclear safety case and is not proprietary information, the redaction is not justified and this information and the same for each of two Assessment Findings raised should be disclosed.

It is not clear why it has been necessary to compile the outstanding GDA Issues COARs,[29] which are primarily directed towards a public audience, in such a way that certain of these have had to be heavily redacted for publication. Redaction of segments of text, diagrams and tabulated data disrupt the flow of reasoning so much so, particularly in GI-UKEPR-RC-01 dealing with hydrogen and radio-iodine, that whole sections of the reckoning cannot be or are extremely difficult to follow and comprehend.

29 Although not reviewed here, certain of the Step 4 reports have also been subject to redaction – for example, *Step 4 Civil Engineering and External Hazards Assessment*, Assessment Report: ONR-GDA-AR-11-018, November 2011

Where the redaction relates to proprietary information (layouts, dimensions, design details and/or a commercial process, etc) then, on a commercial basis, the redactions may be justified but, that said, it is not at all clear why it was necessary to include such detailed information in the COARs if these reports were primarily aimed for public dissemination. A similar line of reasoning applies to redactions made on grounds of security where, obviously, a well compiled narrative could have circumvented any detail that would be at all helpful to those of malevolent intent. It is difficult to reason why, in instances as GI-UKEPR-IH-04, the redactions have been so broad brush as to actually obliterate the captions of redacted diagrams, graphs and figures, or perhaps this is nothing more than the acts of overzealous '*weeders'*.[30]

There also redactions of sections of the COARs that seem to relay information on the consequences of accidents, the risk of accidents and/or variations of accidents but it is not clear, because the detail is not available, whether these variations are within the design basis of the established and evaluated accident scenarios. Examples of this are to be found in the assessment of an incident that liberates combustible gas (GI-UKEPR-FS-03) where the amount of radio-iodine available for release off-site is redacted; and, again for example, in the internal missile analysis GI-UKEPR-IH-04 in which the knock-on or potential cascading of potential missile events are redacted.

Jargon and Jabberwocky: Jargon also serves to detract from a full understanding of the COARs and, hence, justification of the ONR's decisions relating to these. For example, many of the Assessments Reports include the phrase *'GDA followed a step-wise-approach in a claims-argument-evidence hierarchy'* which to many, including the author of this Review, is little more than pure jabberwocky.[31] The Assessment Reports are littered with other jargon such as *'cross-cutting'*, *'deliverables'*, *'handover package'*, *'tracker'* etc., all of which require some explanation.

Confidential and Withheld Source References: Another form of withholding information is that of the COARs referring to and relying upon referenced papers and reports which are not publicly available. In the preparation of this Review, a number of requests for COAR referenced documents were refused by the ONR.[32]

IN CONCLUSION

It was beyond the scope of this Review to assess the technical and engineered basis of the ONR's decision to grant the *Final Design Acceptance Compliance* (F-DAC) for the EPR nuclear plant, Instead, the Review has examined the structure of the GDA process, concentrating on the final phase during which the outstanding GDA Issues identified by the Step 4 process have been *'settled'*.

The conclusion is that certain of the GDA Issues have, in fact, **not** been settled but deferred via *Assessment Findings* for later resolution at various times during the construction and, possibly, commissioning phases of the plant. Where specific plant design issues have been examined in some

30 *'Weeder'* a somewhat disrespectful term for those civil servants, usually retired, who sometimes meaninglessly redact government papers before being made public at the Public Records Office, although not as imaginative as Yossarian's games with the letters home – *Catch-22*, Joseph Heller, 1961

31 Through the Looking-Glass and What Alice Found There, Lewis Carroll, 1872

32 In one ONR response to a request for 8 fully cited reports the ONR considered the requested to be *'manifestly unreasonable under Regulation 12(4)(b) of the Environmental Information Regulations, because the resource required to answer them, together with the time already spent, would require an unreasonable diversion of resources from the provision of the public services for which ONR is mandated. The requests you have sent to ONR have imposed a significant burden on the organisation and there is every indication that you will continue to make further requests for information that would add to that burden.'* – see Large & Associates CZ3206 for full details of the FOIA and EIR exchanges.

detail (in this Final and by the two previous Interim stages of this Review), the finding has been that the design, development and testing of specific hardware systems (the NCSS) and the demonstration of nuclear safety (the SBO Sequence safety case) all remain incomplete.

This Review does not form an opinion on the safety of operation of the EPR plant proposed for the Hinkley Point C and Sizewell C new nuclear build sites. Instead, it has considered whether the *Generic Design Assessment* has demonstrated, so far as is reasonably practicable, that such a future EPR nuclear plant will operate at acceptable risk and tolerable consequences of radiological impact on the environment and members of public. The Review concludes that particularly in this demonstration the GDA is incomplete.

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