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GDA – Step 4

The emerging picture of AP1000

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GDA – Industry Event - 23/11/10

The emerging picture of AP 1000

- Progress & Metrics
- Systems assessment
- Engineering & Hazards assessment
- MSQA, Radwaste & Decommissioning, Radiation Protection
- Cross-cutting topics
- Environment Agency
- Security
- Forward Milestones
- Achievements

GDA – Progress

- EA consultation completed
- 278 meetings held with Westinghouse during Step 4
- TQ – 1132 raised / 978 closed
- ROA – 201 raised / 127 responded to fully / 41 closed
- Technical Convergence meetings ongoing



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GDA Project Status – Quality – Metrics October 2010

<p>Technical Area</p> <p>Item</p>	<p>Internal Hazards (1)</p> <p>Civil Engineering (2)</p> <p>External Hazards (3)</p> <p>Probabilistic Safety Analysis (4)</p> <p>Fault Studies (5)</p> <p>Control & Instrumentation (6)</p> <p>Essential Electrical Power Systems (7)</p> <p>Fuel Design (8)</p> <p>Reactor Chemistry (9)</p> <p>Radiation Protection & Level 3 PSA (10)</p> <p>Mechanical Engineering (11)</p> <p>Structural Integrity (12)</p> <p>Human Factors (13)</p> <p>Management for Safety & Quality Assurance (14)</p> <p>Rad Waste & Decommissioning (15)</p> <p>Environmental Issues (16)</p> <p>Security (17)</p>
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* Is GDA on track to complete a meaningful assessment by June 2011?



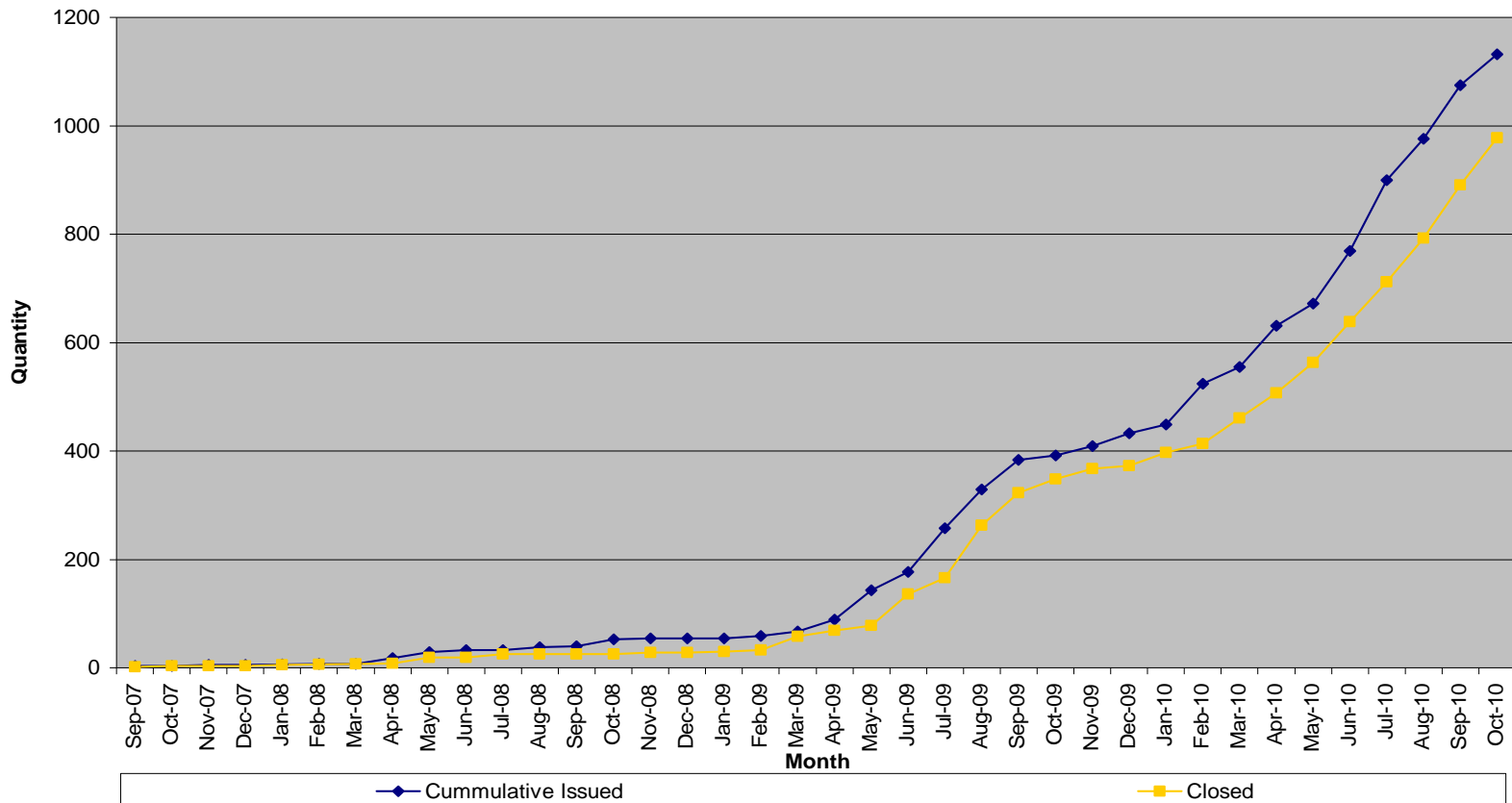
Is the depth, quality and timeliness of interactions, submissions and the responses to TQs ROs and RIs adequate?

- to date
- predicted

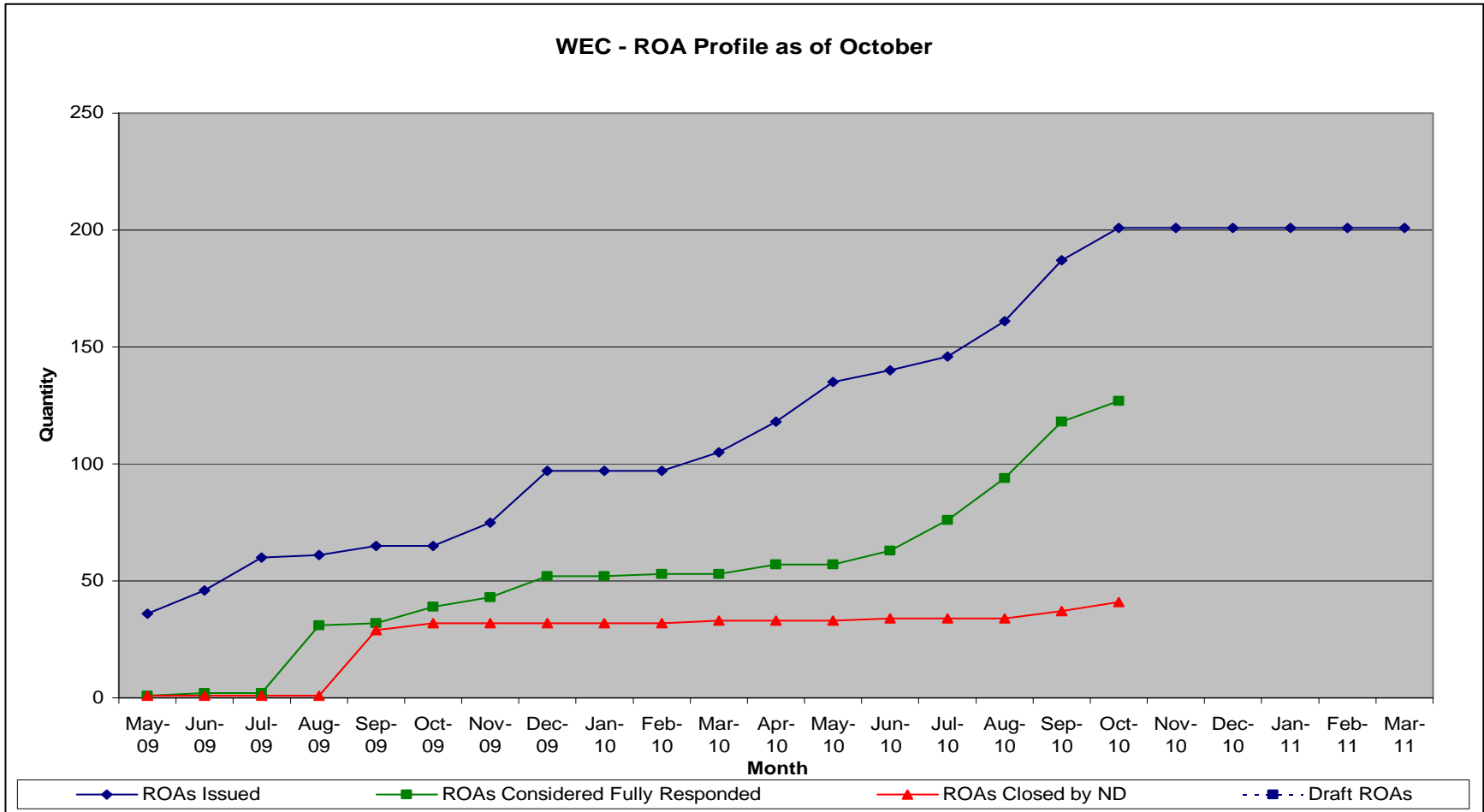


GDA Project Status – Quality - TQ

WEC - TQ Profile as of October



GDA Project Status – Quality - ROA



Systems Assessment – Bob Jennings

- PSA
- Essential Electrical Systems
- Fuel and Core Design
- Fault Studies & Severe Accidents
- Control & Instrumentation
- Human Factors
- Functional Categorisation & SSC Classification

PSA

- The AP1000 PSA is over reliant on the AP600 PSA
- Level of detail and completeness of PCSR is not consistent with our expectations
- We are conducting a risk gap analysis to try to put a bound on the deficiencies when comparing with SAP numerical targets
- Recent TSC delays now resolved
- Interactions and openness between WEC's and ND teams
- Timeliness providing feedback on reviewing reports and TQ responses etc

PSA

Potential GDA Issues

- The need to update the PSA particularly, although not exclusively, updating the success criteria to AP1000 analyses
- Hazards PSA – Fire PSA currently our focus

Potential Assessment Findings

- The PSA report does not describe a systematic assessment process to identify Initiating Events (IEs).
- The identification process for "generic" IE events relies almost completely on NUREG/CR-3862 (May 1985).
- The process for grouping IEs is not clear, i.e. the grouping criteria and the mapping to derive the final initiating fault groups are not transparent

Electrical Engineering

- Major challenge due to the significant difference in SSC Classification.
- PCSR very limited in scope and very high level.
- Supporting references difficult to follow and often went from very high level to extremely detailed quantitative analysis.
- The basic UK design was the standard reference plant based on 60Hz whereas the design reference in electrical engineering was to the Chinese 50Hz plant.
- No initial consideration of the important role that SMART devices play in the safety of the plant or the fact that WEC would need to talk to its suppliers about meeting key Class 1 and Class 2 standards for these components. Recently this has improved considerably.

Electrical Engineering

Potential GDA Issues

- A potential GDA Issue has been raised on the adequacy of the PCSR as the latest draft still fell short of our expectations in this area in terms of completeness and consistency.

Potential Assessment Findings

- The requirement to provide a philosophy for the segregation of electrical cable routes for Class 2 systems. The present philosophy only considers Class 1 systems and it will be a requirement to also provide a philosophy for Class 2 systems .

Fuel and Core Design

- Fuel and Core design evolution of and modest extensions to 50 years of experience
- No major surprises, work generally to a high standard after a difficult start.
- Use of a very dated code (PAD) give some concerns over the analysis when compared to modern standards.
- The planned use of a complex code BEACON has not been satisfactorily justified in terms of its potential failure modes

Potential GDA Issues

- The safety case does not account for the affect of CRUD

Potential Assessment Findings

- A detailed programme of surveillance needs to be agreed with the licence to ensure that the fuel conforms to the assumptions of the safety case. This needs to be agreed before first fuel loading and will benefit from experience in other plants

Fault Studies –

- Interactions with WEC have been good and assessment progressing well
- The DCD did not provide adequate demonstration of diversity for frequent faults – PCSR is being developed to provide this evidence
- Initial safety submission covering frequent faults had to be re-worked but recent quality of submissions has improved
- In order to provide adequate protection for all frequent faults the active systems have had to be upgraded in classification to class 2
- The provision of diverse flux protection appears to fall short of that provided in the most modern AGRs and SZB
- Significant challenges on the concept of early boiling of the spent fuel pool
- List of initiating fault not considered to be complete since internal external hazards are missing

Fault Studies –

Potential GDA Issues

- Potential for spurious actuation of the protection system
- Level of diversity to protect against some faults
- Possible need for additional C&I functions
- Consequence of single failures
- Completeness of the fault schedule

Potential Assessment Findings –

- Still under evaluation at this stage – likely to focus on more detailed confirmatory studies as the design becomes more detailed

Severe Accidents

- Our severe accidents assessment work started very late.
- It is an extremely complex area involving cutting edge computational software and the interpretation and scaling of equally complex experiments.
- AP1000 uses the ‘in vessel retention’ and controls hydrogen by electrically operated hydrogen burners..
- A pragmatic approach has been adopted due to the modest risk reduction claimed for the severe accident measures
- More like a balance of probabilities approach as opposed to a beyond reasonable doubt applied to DBA analysis.

Potential GDA Issues

- No GDA Issues expected.

Potential Assessment Findings

- Will focus on improving some of the models to help inform severe accident response measures.

Control and Instrumentation

- Very significant challenge due to the one safety class approach adopted for the AP1000.
- The main reactor protection system (PMS) was developed from complex computer-based components (AC160) designed for routine industrial control.
- The Diverse Actuation System (DAS) was not tolerant to single failures and would be required to be out of service either due to faults or proof testing during full power operation over a typical 12 – 18 month between outages.
- Both the DAS and a highly complex component called the Component Interface Module (CIM) were being designed and implemented by a small company with very limited experience of Class 1 Safety Systems.
- USNRC audit of the DAS/CIM manufacturer showed a number of areas for improvement when judged against Class 1 standards. Our audit of the documentation showed similar problems as did WEC's own audit.

Control and Instrumentation

In response to the problems stated above WEC has committed to:

- Change the design of the DAS
- Change the technology of the DAS to very simple electronics sourced from a different manufacturer than the CIM.
- Undertake a number of compensating measures to make up for the deficiencies found in the CIM design process, including design changes
- Introduce a fully diverse and very simple blocking circuit for the spurious PMS initiation of the ADS valves WEC is.
- Revise safety cases for the PMS, CIM and DAS to bring into line with UK practice.

Control and Instrumentation

Potential GDA Issues

- Largely linked to having a more complete analysis of and solution to the issues raised above

Potential Assessment Findings

- Assessment findings will largely be derived from getting the evidence from the commitments WEC has given about detailed design phase and later commissioning and testing activities

Human Factors

- Focus on HF was initially on the design of the main control room.
- There was HRA in the PSA but with no justification.
- WEC responded with a large team to deliver a programme of HF safety analysis submissions
- WEC will provide sufficient information for us to complete a meaningful report.
- However, major submissions will be delivered late in our assessment process and may not be able to be included in our Step 4 report.

Potential GDA Issues

- Completeness of the Human Factors Safety Case

Potential Assessment findings

- Update the Human Reliability Assessment (HRA) to incorporate the qualitative Human Factors work undertaken in GDA; particularly relating to Type A human errors

Functional Categorisation and SSC Classification

- UK follows international best practice by having the safety function categories and three SSC classifications. This makes for four Classifications if non-safety is included.
- There is not necessarily a one-to-one mapping.
- The AP1000 is based on US practice of having just one safety class for all SSCs (there are a number of QA Classes within that particularly associated with Structural Integrity)
- This has caused considerable difficulty for both WEC and ND.
- This was more than a re-naming convention as, particularly Class 2 systems have higher level of equipment and architectural requirements than most US non-safety systems important to safety.
- No link between PSA claims and SSC Class.

Functional Categorisation and SSC Classification

- WEC has made significant progress in resolving this issue over the past few months.
- The Generic PCSR when completed will reflect the UK approach on Cat and Class although in individual technical areas more work will need to be done on the justification of design changes.
- NO GDA Issue expected and the Site Specific PCSR should come fully updated.



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Engineering Assessment – Andy Cadman

- Internal Hazards
- Civil Engineering
- External Hazards
- Mechanical Engineering
- Reactor Chemistry
- Structural Integrity

Internal Hazards

- Assessment gone through several iterations.
- Westinghouse have had to develop a more comprehensive safety case for Internal Hazards.

Potential GDA Issues

- Need to identify and substantiate nuclear significant barriers.
- A detailed analyses for internal flooding for each of the AP1000 Nuclear Island buildings needs to be developed.

Potential Assessment Finding

- We will need to sample the evidence in the Hazard Barrier Matrix to confirm that the claimed evidence has been added.

Civil Engineering

- This topic has been dominated by the novel use of steel, concrete, steel modules for many of civil engineering structures. This has resulted in a Regulatory Issue. The last major submission for the RI has recently been received. Overall we have a positive view about the submission but we still have some detailed assessment to complete.

Potential GDA Issues

- The timescales to resolve RI and complete our assessment of the Enhanced Shield Building are very tight so some aspects of the Civil design may become GDA issues.

Civil Engineering

- Metrication and substitution of materials. Westinghouse's policy that US materials will be used throughout may cause detailed design and construction problems.

Potential Assessment Finding

- The GDA design is for a 60Hz turbine. The safety related first bay of the building is isolated from the rest of the building by a gap. The seismic analysis for the 50Hz turbine building must be re-run and the gap confirmed.

External Hazards

- Good progress has been made in assessing the External Hazards

Potential GDA Issues

- None

Potential Assessment Finding

- Site Response Spectra. The GDA design is for a US range of sites. Once a site has been chosen a comparison will be needed with the actual site spectra

Mechanical Engineering

- Assessment process has generally gone well
- Specifically we are now satisfied with the responses to our concerns over the ventilation systems and our focus will now shift to ensuring that this is adequately captured within the GDA design

Potential GDA Issues

- Squib valves / pyrotechnics Although progress has been made in this area, much work remains to be done. The maintenance / surveillance requirements need to be finalised as there is a potential to impact the current building layout and civil design
- Metrication. Although Westinghouse have stated that they accept the ND guidance in this area, the exceptions list provided does not reflect the spirit or letter of this guidance

Mechanical Engineering

Potential Assessment Finding

- Sample of works acceptance tests, commissioning tests and system tests to confirm that the mechanical equipment that is procured meets the design intent

Reactor Chemistry

- Assessment started late and is back end loaded. There is still a lot of assessment to do

Potential GDA Issues

- Evidence that the primary sampling system is suitable for control of the primary plant chemistry
- Fission product control through sprays and In Vessel Retention Chemistry

Potential Assessment Finding

- ND to examine arrangements for hot functional testing to get confidence that this important pre-conditioning will achieve the necessary result

Structural Integrity

- UK has a structured approach to demonstrating the integrity of the highest integrity components which it has applied to all types of reactors over many years. We made good progress with our assessment of the AP1000 with agreement having been reached on the approach to the major issues

Potential GDA Issues

- The timescales for the delivery of some of the fracture analyses work for the components of highest safety significance are very tight
- Justification of the main reactor coolant pump bowl. This is due to a major design change

Structural Integrity

Potential GDA Issues - continued

- Details on the safety classification of some components need to be clarified to avoid an issue
- The fatigue analyses for components such as the surge line still need to be resolved

Potential Assessment Finding

- Sampling of the implementation of the qualification programmes for all the manufacturing, pre-service and in-service inspections of the highest integrity components.

Dave Watson

- MSQA
- Radwaste, Spent Fuel & Decommissioning
- Radiation Protection
- Cross-Cutting Topics

MSQA

- QMS for Project adequate
- High level processes for design development, design change and configuration control OK
- Further work is needed on application of design change and configuration control to the UK GDA.

Potential GDA Issue

- Risk of lack of consistency between design reference and developing PCSR. (see related cross-cutting Issue)

Potential Assessment Findings

- Supply Chain quality associated with manufacturing eg Long leads
- QA arrangements for the detail design development from GDA to UK site specific projects

Radwaste, Spent Fuel and Decommissioning

- Has looked at types of waste produced, it's minimisation, storage and management; and decommissioning
- Spent fuel is assumed to be a waste
- Some work still ongoing (eg spent fuel storage, decommissioning and decontamination) and further progress expected within Step 4

Potential GDA Issues

- None anticipated

Potential Assessment Findings

- Management of long term spent fuel storage
- Radwaste handling facilities appear too compact
- Spent fuel stores
- Decommissioning plans further development
- Fuel limits = new uranium in new fuel, 65MWd/t, 5%enrichment etc

Radiation Protection

- Has looked at source terms, radiation zoning, shielding external and internal operator dose levels, health physics facilities etc

Potential GDA Issues

- Criticality safety case for spent fuel storage
- Health Physics facilities (labs, workshops, changing and monitoring facilities) and waste handling areas too compact

Potential Assessment Findings

- Mid Loops Ops (& SG inspection)

Cross-Cutting Topics

- Many are covered by assessor leads – severe accidents; source terms; safety classification
- Others are project lead – Design Reference, Design Change, Limits and Conditions

Potential GDA Issues

- Provide an update of the GDA Submission (PCSR, Design Reference etc) for inclusion in the Final DAC:
 - Changes arising from Resolution Plans / other design changes
- To provide a metric design for the Final DAC
 - Civils aspects e.g. rebar and beams
 - Mechanical Engineering aspects e.g. bolts
 - (and possibly safety case documentation)



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Cross-Cutting Topics

Potential Assessment Findings

- Operational limits
- Maintenance plans
- Commissioning plans

Environment Agency

- Consultation ended 18 October 2010
- Joint assessment work ongoing
 - MSQA
 - Decommissioning
 - Spent fuel disposability

Potential GDA Issues

- Design reference update (Common with HSE)

Potential Assessment findings

- As set out in the Consultation document

Security – Robert Rodger

- Vital Area Identification
- Conceptual Security Arrangements

Potential GDA Issues

- None anticipated

Licensing Process

- OCNS looking for CSA commitment to be followed through

Forward Milestones

- Joint Plan to finish Step 4
- Technical Convergence meetings due to complete - December '10
- Consolidated PCSR/PCER and Design Reference Point - 31 March '11
- Level 1 and 2 meetings arranged through remainder of Step 4
- Decision on close out of GDA Issues – 31 March '11
- End of Step 4 and decision for DAC/SoDA or Interim DAC/SoDA - June 11

Achievements

- Westinghouse has worked hard to meet the challenges
- Excellent relationships and communication
- Ability to have open, honest and robust discussions
- Agreed and kept to 'No surprises'
- Convergence meetings – process has worked
- No showstoppers
- Looks like an Interim DAC/SoDA in June 2011
- Resolution Plans will signal the end of GDA process



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Questions?