Senate Standing Committee on Environment and Communications
Legislation Committee
Answers to questions on notice
Environment and Energy portfolio

Question No: 174

Hearing: Budget Estimates

Outcome: Outcome 3

Program: Australian Antarctic Division (AAD)

Topic: Icebreaker - Risks

Hansard Page:

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Question Type: Written

Senator Xenophon asked:

What are the current risk items (in the project risk register)?

Answer:

The current risk items, existing controls, and proposed risk treatments are listed in the table below. Please note that this table also addresses the other question asking what the mitigation and fall-back strategies are for each of the risks.

Risk Description	**Existing Controls**	**Proposed risk treatments**
Limited Experience: There is a risk arising from the limited overall experience of DMS and Damen Schelde in designing, building, outfitting and delivering a bespoke vessel of this nature (type / size).	● Damen have collaborated closely with Hamburg Ship Model Test Basin (HSVA) in Hamburg Germany who are an independent company that provide services to new build projects including design / optimisation, model testing, and numerical predictions ● Comprehensive process is set out in the Contract to cover the design, construction and acceptance testing processes which provides appropriate level of oversight from the Project in terms of reviewing evolving vessel solution ● Project budget has been developed to ensure that appropriate level of resources (including external SMEs) and travel costs for attendance at key review activities	● Project to rigorously enforce the provisions of the Contract relating to the design review processes to ensure that progressive verification and validation of user requirements is completed as per Statement of Work and FPS ● Project to provide detailed review of design deliverables including progressive updates to key phase management plans (including build and transition) which are not already issued as final ● Ensure that project budget for external SME support (in particular project management and technical management roles) is utilised to the maximum extent possible - including having these SMEs involved in routine progress meetings and reviewing contract status reports

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Project Contingency Risk There is a risk that the Department's own contingency for the Project of around $8 million is insufficient to address issues that arise during the Design & Build Phase.	• All design opportunities identified and agreed by the Department during evaluation have been now incorporated into the fixed-price contract. • The Department has implemented a modification approval process with appropriate governance oversight to manage any design change requests. • The Department has ensured that appropriate level of project resourcing is in place to provide oversight of the contractor. • The Department has entered into an arrangement with Department of Finance to manage the risk of foreign currency variations affecting Payments in EUROS during the Design & Build Phase.	• Project to ensure that end-users have an active role in the design review process. • Project to ensure regular communications and meetings are held with the contractor. • Project to actively manage the design review process and to address any queries to ensure that the Department does not become liable for design changes. • Project to monitor the build phase activity. • Project to activate the contract protections to ensure that the contractor addresses any design or build issues in accordance with their obligations.
Schedule Risk There is a risk that delays may result the research supply icebreaker not being available in Hobart to commence Antarctic season in October 2020.	• The contract includes strong commercial incentives for the contractor to achieve final acceptance on schedule. • The contract includes strong reporting and remedial obligations for the contractor to address delays. • The contract includes 20 milestones to ensure that progress can be monitored. • The contracted schedule provides contingency in the delivery phase to Hobart should there be delays achieving final acceptance in the Netherlands. • The contractor has now completed all design reviews and milestones required to allow steel-cutting to commence.	• Project to ensure regular communications and meetings are held with the contractor. • Project to actively manage the design review process and to address any queries in a timely manner to ensure that the Department does not cause delays. • Project to monitor progress and milestones, and to actively manage any potential delays. • Project to conduct further schedule reviews in early 2018 and early 2019 • The Department could potentially delay or shorten the 2020/21 season, and/ or use capacity of other nations vessels on a short-term basis for essential activity.

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DMS Project Management There is a risk that DMS as project manager of the D&B Subcontract could introduce additional risk to the on-time delivery of a vessel that is compliant with the Contract (including Statement of Work).	● Schedule 3 includes Milestone Events that require DMS activities to be in accordance with the DMS Project Management Plan prior to payment ● DMS have utilised external maritime specialists to provide resourcing and project management support during design and engineering phase ● Project will be notified when Key Personnel are recruited as DMS will need to seek approval under the provisions of clause 18	● Project to actively make best use of early contract Progress Meetings and Contract Status Reports to ensure that DMS are aware that Project is monitoring this risk
Design and Build Schedule Overlap The vessel delivery program includes a period of overlap between the completion of the design process and the commencement of vessel construction which introduces an element of risk.	● The existing controls in place include a delineation of the technical documentation that is to be considered as part of each design review to address timing requirements, capturing key activities during this overlap between in the Milestone Events including the completion of the Build Readiness Review prior to construction commencement which requires Department confirmation that construction can commence with low risk.	● See Project Schedule Management Protocol Issue 1.1 (2015_08_06) ● The mitigation of this risk relies on thorough and effective management of the various design review processes by the Project. ● Ensure that outcome of FDR1 and DDR1 will put the Project in a position to meet the Build Readiness Review to commence construction at low risk taking into account the state of the design
FPS to Technical Specification Translation The Function and Performance Specification (FPS) includes a set of output based requirements that rely on a process of progressive translation into a detailed prescriptive Technical Specification based on the evolving solution that will also take into account the specific needs of the operator / maintainer. This process introduces an interface risk between specifications due to potential misunderstanding between the parties.	● The existing controls in place include the fixed price lump sum arrangement for delivery of the vessel that is compliant with the FPS and acknowledgements within the Statement of Work that the review and submission of the Technical Specification does not in any way diminish the Contractors obligations under the Contract.	● The mitigation of this risk relies on thorough and effective management of design review processes by the Project, including internal processes to ensure that no scope creep occurs during review of design deliverables. ● See Project Scope Management Protocols Issue 1.1 (2015_08_06)

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FPS to Technical Specification Translation The Function and Performance Specification (FPS) includes a set of output based requirements that rely on a process of progressive translation into a detailed prescriptive Technical Specification based on the evolving solution that will also take into account the specific needs of the operator / maintainer. This process introduces an interface risk between specifications due to potential misunderstanding between the parties.	● The existing controls in place include the fixed price lump sum arrangement for delivery of the vessel that is compliant with the FPS and acknowledgements within the Statement of Work that the review and submission of the Technical Specification does not in any way diminish the Contractors obligations under the Contract.	● The mitigation of this risk relies on thorough and effective management of design review processes by the Project, including internal processes to ensure that no scope creep occurs during review of design deliverables. ● See Project Scope Management Protocols Issue 1.1 (2015_08_06)
DMS Operate and Maintain Input DMS may not effectively ensure that appropriate operation and maintenance requirements are reflected in the design solution.	● The DMS Project Management Plan and Design and Engineering Management Plan reflected the involvement of the Master Consultant, this role is filled by an experienced Icebreaker Captain. ● During the RR process, it was evident that DMS have brought in additional expertise who are reviewing the solution from an operations and maintenance perspective.	● Continue to monitor DMS resourcing through the process defined in Contract for changes to Key Personnel ● AAD utilisation of project team, internal SME and external SME resources with both deck and engineering qualifications to ensure that these elements are being reflected in design deliverables
Vessel Size / Dimensions and Fit for Purpose The proposed Vessel is 156 metres in length with 9.3 metres end of service life full load draught. This is considered to be at the upper end of the limit for many operations including routine access to Horseshoe Harbour at Mawson Station. Any further increase in Vessel size may lead to issues in terms of operational limitations. There is a risk that the size of the vessel may need to be increased during the Design phase, to be able to incorporate all specified requirements.	● A range of effective mitigations have been identified by the project team to ensure no or minimal dimensional changes arise during the design process. ● Design activities before contract signature to ensure main requirements have been incorporated into concept design ● The Contract includes obligations on the Contractor to ensure that the vessel has the dimensions and characteristics set out in Schedule 1 – Contract Particulars. The limitations relating to vessel dimensions agreed with DMS have been included in this schedule.	● See Project Scope Management Protocols Issue 1.1 (2015_08_06) ● Technical performance measures have been established in the Project Engineering Management Plan that trigger a risk assessment should the design move outside of the pre-defined tolerance, vessel dimensions are included in this process.

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Bespoke Vessel Design The overall vessel design is bespoke, includes a high degree of complexity in terms of the integration of a large number of individual capabilities (in particular various scientific research capabilities) into a single platform design, and is considered to be at the upper end of the spectrum in terms of vessel size / complexity taking into account the defined operating profile. There is a risk that the design team may not have the necessary knowledge and design references to successfully combine all the user requirements into a compliant design solution.	● There are an extensive range of existing controls in place in the Contract including a comprehensive design and acceptance testing regime and the primary risk treatment requires thorough; and effective management of these defined processes to ensure this risk is mitigated to the maximum extent possible. ● The Statement of Work Design and Build requirements have set out a process of design review and analysis (including computational fluid dynamics and model testing) which provide a level of assurance and early identification and allow for any emerging design issues to be mitigated.	● Thorough analysis of design during planned design reviews and continue to actively monitor as the design progresses. ● Ensure that internal / external SME resources engaged have the relevant expertise to identify potential evolving / emerging issues as they arise
Vessel Complexity / Integration Risk The overall vessel design includes a high degree of complexity in terms of the integration of a large number of individual capabilities (in particular various scientific research capabilities) into a single platform design, and is considered to be at the upper end of the spectrum in terms of vessel complexity. There is a risk that the design team may not have the necessary knowledge and experience to successfully integrate all the individual capabilities into a single platform.	● There are an extensive range of existing controls in place in the Contract including a comprehensive design and acceptance testing regime and the primary risk treatment requires thorough; and effective management of these defined processes to ensure this risk is mitigated to the maximum extent possible. ● The Statement of Work Design and Build requirements have set out a process of design review and analysis (including computational fluid dynamics and model testing) which provide a level of assurance and early identification and allow for any emerging design issues to be mitigated.	● Thorough analysis of design during planned design reviews and continue to actively monitor as the design progresses. ● Continue to monitor the proposed Maker's List as the procurement process continues to ensure alignment between OEMs so that risk can be effectively managed by a smaller number of parties (i.e. Kongsberg are supply all underwater science sensors to reduce integration risk)
Hybrid Propulsion System / AED The proposed propulsion system solution in the DMS tender has been updated to achieve a contractual commitment to Silent R acoustic noise performance requirements.	● The existing controls currently in place include a detailed analysis provided by DMS that was sought by the Negotiation Team, which included: a DMS / Damen response to a series of perceived risks and weakness identified by the Negotiation Team that was subsequently reviewed by specialist SME; a DMS analysis and risk identification of the propulsion system solution prepared by maritime propulsion system experts in the UK; and written confirmation from both DMS and Damen to the effect that the propulsion system is considered suitable, robust and fit for the intended purposes.	● Ongoing monitoring of these risk revolves around the development of a Propulsion System Integration Management Plan that will be prepared by Damen as the design of the system evolves; careful review of the DMS reported risks that form part of the monthly Contract Status Reports; and thorough review of updated technical specifications and final selected equipment suppliers from the Maker's List.

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Acoustic Noise Performance / Compliance There is a risk that the vessel will not achieve the contracted acoustic noise performance requirements.	● Statement of Work requires ENG-460 Acoustic Performance Analysis to be produced which includes all noise predictions relating to UWN and SSN due to various noise sources. ● Project has put in place TKMSA and Tim Gates Acoustics as expert acoustic noise SMEs with experience in both engineering analysis and full-scale noise measurements ● Damen Schelde as a naval shipbuilder have a demonstrated level of expertise in delivering ships against noise specifications including scientific research builds	● The initial project review of ENG-460 has not led to any major specific concerns about the ability of the design to comply with these requirements. A Noise Equipment List has been generated by Damen to substantiate their analysis. ● The Project attended propeller cavitation tests at HSVA which predict full-scale propeller cavitation will occur at approximately 8.3 knots which exceed minimum 8 knots requirement. This means that propeller noise should not be dominant noise source, however further refinements to propeller design mean further tests are underway.
Controllable Pitch Propellers (CPP) There is a risk that the CPPs cannot be designed and manufactured to comply with both the icebreaking and acoustic noise requirements.	● Contract Schedule 18 includes a Maker's List which at the time of contract signing only permitted Rolls Royce and Wartsila to supply CPP units. These companies are global leaders in the field.	● Serco through MGT-120 have advised that Rolls Royce will be the manufacturer of these units, and that propeller design has already changed to support manufacture with previously built units. Propeller hub size has increased which enhanced robustness with potential adverse impact to noise performance. ● Cavitation testing on the Rolls Royce propeller units is occurring in October 2016 and cavitation inception speed and other performance characteristics will be assessed through FDR1.
Excessive Fuel Consumption The design development during contract negotiation process has resulted in an increase in the level of fuel consumption predicted for the vessel, arising from the completion of calm water and irregular waves model testing. There is a risk that the overall fuel consumption of the vessel will be higher than anticipated.	● The Contract has in place a range of controls including: placing limitations on overall vessel size and lightship weight; inclusion of the main engines and diesel generators selected by the Contractor for incorporation into the vessel in the Maker's List; and a regime of Liquidated Damages has been agreed to ensure that engines installed in the Vessel do not exceed guaranteed levels. ● Fuel consumption is presented in ENG-420 Powering and Endurance Analysis which is also informed by actual model testing results for both calm water and added resistance in waves.	● The primary ongoing treatment to this risk is the recording of key vessel parameters (including lightship weight) in the Project Engineering Management Plan as technical performance measures whereby a risk assessment is triggered where these parameters move outside of permitted tolerances. ● Project may need to consider special instructions / agreement for Contractor operation of the vessel taking into account fuel consumption. This takes into account the high variability of fuel consumption depending on environmental conditions.

Risk Description	Existing Controls	Proposed risk treatments
Deep Water Systems The design of vessel systems may not meet the defined capability requirements at maximum required depth.	● The FPS / Contract requires special sea trials to be conducted in the maximum water depth available in area that trials will occur, and in no case less than 2,500 metres. ● In ensuring Final Acceptance occurs in the Netherlands, the Project is able to provide instructions to DMS through a voyage plan that additional tests are conducted during the delivery voyage where deeper water may be found (generally addresses acoustics but not deployments). ● A range of contractual provisions mitigate the circumstances where ultimately the vessel capability is insufficient, primarily through defined warranty provisions.	● The Makers List ensures that only reputable OEMs are included, and through MGT-120 it has been confirmed that Kongsberg and Triplex / RAPP will be the suppliers of underwater sensors and winch systems respectively. These two companies are the world leaders in their respective fields and have extensive experience with deep water performance requirements relating to their systems. ● Project to ensure that appropriate internal / external SME resources are applied to reviewing the proposed design solution (equipment specifications / system specifications) to achieve these requirements.
Requirements Management (RM) The progressive translation of FPS requirements into a prescriptive Technical Specification and lower level build specifications, needs to be managed throughout the Design and Build phase in a thorough Requirements Management process, to ensure the fulfilment of stakeholder requirements. There is a risk that DMS and Damen's RM process is not robust enough to ensure that all stakeholder requirements are analysed, translated and implemented correctly into the final solution.	● The existing controls in place include the fixed price lump sum arrangement for delivery of the vessel that is compliant with the FPS. ● A comprehensive Requirements and Design Review process as specified in the Statement of Work, to ensure that all requirements are correctly interpreted and implemented in the design and build ● A comprehensive Verification and Validation program as specified in the Statement of Work and VCRM, to verify that all requirements are correctly interpreted and implemented in the design and build	● The mitigation of this risk relies on thorough and effective management of design review and verification and validation processes by the Project. ● The Project in preparing for design review processes has commenced a process of mapping evidence documents (Serco Tier 3) to FPS requirements (Serco Tier 1) to ensure that a requirements trace is occurring. This will reveal any shortcomings at each design review and requires progressive completion and checking of this process.

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Verification and Validation (V&V) The progressive translation of FPS requirements into a prescriptive Technical Specification, lower level build specifications and ultimately into the as-built icebreaker, needs to be verified and validated throughout the Design and Build phase in a thorough and suitable Verification and Validation Management process, to ensure the fulfilment of stakeholder requirements. There is a risk that DMS and Damen's (V&V) process is not thorough enough to ensure that all stakeholder requirements are implemented correctly into the final solution.	● The existing controls in place include the fixed price lump sum arrangement for delivery of the vessel that is compliant with the FPS. ● A comprehensive, integrated V&V program as specified in the Statement of Work and VCRM, to verify and validate that all requirements are correctly translated and implemented in the design and build.	● The mitigation of this risk relies on thorough and effective management of design review and verification and validation processes by the Project. ● Ongoing review of the Serco V&V Plan after each key design review activity to ensure that its processes and procedures are working ● Continued discussions with Serco / Damen to ensure remaining phases of V&V program are done correctly.
Propulsion System - Icebreaking Capability The proposed hybrid propulsion system has not previously been used in icebreaking applications. There is a risk that the different operating characteristics of individual components may not interact effectively during icebreaking operations and result in a reduced icebreaking capability.	● The baseline design incorporates conventional icebreaking features such as a Heavy Flywheel, spare power capacity in main engines and fast propeller pitch reduction. ● The baseline design provides for a failure of the flexible couple of AED unit to not render the remainder of the drive-train inoperable.	● DMS and Damen have undertaken to implement a comprehensive Propulsion System Integration Management Plan which will include Torsional Vibration Analysis and Dynamic Simulation. ● DMS and Damen have also identified additional technical solutions that may be implemented if the existing controls are not effective.
Propulsion System - Control System and Control Integration The proposed hybrid propulsion system has not previously been used in icebreaking applications. There is a risk that the control systems of the different propulsion system components may not interact effectively during icebreaking operations and result in a reduced icebreaking capability.	● The propulsion system operating concept for icebreaking operations (high, fixed shaft speed) was chosen to utilise maximum inertial momentum from the drive train and to minimise the level of control interactions with the sub-systems and components of the system. ● Project has ensured that D&B Subcontract includes specific obligations for the development of the Propulsion System Integration Management Plan and Risk Assessment.	● DMS and Damen have undertaken to implement a comprehensive Propulsion System Integration Management Plan which will include Torsional Vibration Analysis and Dynamic Simulation. ● DMS and Damen have also identified additional technical solutions that may be implemented if the existing controls are not effective.

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Delegated Engineering Authority - The DMS engineering delegated authority process may not be followed.	● The Serco Design and Engineering Management Plan is a Schedule 23 document in the contract, and as such it does not have precedence over other Contract provisions but requires Serco to follow its processes.	● The Project in accepting design deliverables from DMS is ensuring that formal document transmittals are being provided from Serco to AAD to ensure that DMS takes ownership of deliverables. ● The Project has not been accepting deliverables where it is clear that DMS has not initially viewed these documents, delivery of FRD1 Tranche 1 and 2 process indicates that DMS are properly reviewing documents prior to release of AAD. ● Ensure that DMS is endorsing design deliverables in accordance with its delegated engineering authority process at upcoming design reviews.
Defects – D&B Phase The AAD may incur additional costs arising out of Defects during the D&B Phase.	● Contractual provisions with Serco (and Serco with Damen through D&B Subcontract) will incentivise performance during D&B Phase and establishes appropriate risk management behaviours.	● Ongoing monitoring / mitigation of D&B Risks will be addressed through the totality of managing all other technical risks in this register. ● Further ongoing treatment actions will include further consideration to how AAD will be represented within the shipyard (ranging from DMS presence only with intermittent AAD milestone based visits through to a level of permanent representation by AAD (or external adviser) during the construction phase. This treatment is dependent on final DMS make-up of Build Team.

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Defects – O&M Phase The AAD may incur additional costs arising out of Defects that are later discovered during the D&B Phase.	● Contract addresses allocation of risk which will cover the vast majority of design defect events. ● Warranty period and further latent defect period will reduce any potential events in the first 5 years. ● The sub-contract was enhanced to reflect the 30 year design life and Serco still has a considerable interest to get the vessel 'right' as it will operate the vessel for 10+ years and possible impacts on unscheduled maintenance. ● Systemic analysis of the vessel during the first 5 years will help identify any issues during the warranty and latent defects period. The initial inspection after the first season of operation (possible dry-docking) will assist this process.	● Ongoing monitoring / mitigation of risk will be addressed through the totality of managing all other technical risks in this register. ● Further ongoing treatment actions will include further consideration to how AAD will be represented within the shipyard (ranging from DMS presence only with intermittent AAD milestone based visits through to a level of permanent representation by AAD (or external adviser) during the construction phase. This treatment is dependent on final DMS make-up of Build Team. ● Develop detailed planning for the commissioning season dry-docking process in addition to warrant period planning within the Transition Plan and other project documents that will be developed over the next four years.
Displacement (Lightweight / Deadweight) There is a risk that during the design development and further analysis of the user requirement, the overall displacement of the vessel may be greater than anticipated.	● A Weight Control Procedure has been established by Damen that includes progressive lightship weight estimates and monitoring (including weighing) during construction ● Consumption of weight margins are being reported by Damen ● In addition to margins, Damen has also based design appraisal of hull structure on a scantling draught of 9.3 metres providing a margin over the 9.2 metres design draught	● AAD to ensure that modifications to specification are minimal to ensure that existing service life margins are maintained to the extent possible ● Project has established technical performance measures relating to vessel dimensions / displacement to trigger a further risk-assessment where the weight goes outside of pre-determined tolerances ● Thorough review of lightship weight estimates (and margin consumption) during D&B Phase, in addition to design deliverables including ENG-500 Stability Analysis

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Loading, Discharging and Carriage of Cargo Fuel and Hazardous Goods There is a risk that during the design and build stage only regulatory requirements are considered regarding the loading, discharging and carriage of cargo fuel and hazardous goods, and that operational requirements are not sufficiently incorporated to ensure safe and efficient operations. (This is partly related to the "Limited Experience" and "DMS Operate and Maintain Input" risks mentioned earlier.)	● ENG 410 - Operations Workflow and Safety Analysis is required to be prepared by Serco under the Statement of Work ● Contract / SoW have requirements for compliance with IMO / AMSA / IMDG requirements which will be addressed through plan appraisal by Lloyd's Register ● Currently two ex-icebreaker masters are employed by Serco to ensure that knowledge from existing operations can be transferred into the design solution.	● Ensure appropriate internal / external SME expertise is applied to reviewing key design deliverables including but not limited to ENG-410 ● Project to ensure that Serco continue to focus on operations following design completion and that during the build period the SOPs are developed in good time prior to commencement of operations. ● Serco recruitment of key experienced personnel to ensure a transfer of knowledge in AAD operations.
Solid Cargo Operations There is a risk that the design will not facilitate the safe and efficient movement, loading and unloading of cargo.	● ENG 410 - Operations Workflow and Safety Analysis is required to be prepared by Serco under the Statement of Work ● Currently two ex-icebreaker masters are employed by Serco to ensure that knowledge from existing operations can be transferred into the design solution.	● Ensure appropriate internal / external SME expertise is applied to reviewing key design deliverables including but not limited to ENG-410 ● Project to ensure that Serco continue to focus on operations following design completion and that during the build period the SOPs are developed in good time prior to commencement of operations. ● Serco recruitment of key experienced personnel to ensure a transfer of knowledge in AAD operations.
Watercraft Operations, Launching and Recovery There is a risk that the design does not facilitate the safe launching, recovery and safe operations of watercraft. (E.g. Barge launch and recovery, cargo operations with barge while in DP, launch and recovery of tenders while making way.)	● ENG 410 - Operations Workflow and Safety Analysis is required to be prepared by Serco under the Statement of Work ● ENG-490 - Watercraft Analysis to be prepared by Serco under the Statement of Work ● Currently two ex-icebreaker masters are employed by Serco to ensure that knowledge from existing operations can be transferred into the design solution.	● Ensure appropriate internal / external SME expertise is applied to reviewing key design deliverables including but not limited to ENG-410 and ENG-490 ● Project to ensure that Serco continue to focus on operations following design completion and that during the build period the SOPs are developed in good time prior to commencement of operations. ● Serco recruitment of key experienced personnel to ensure a transfer of knowledge in AAD operations.

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Science deployments There is a risk that the design will not facilitate the safe and efficient deployment of science gear.	● ENG 410 - Operations Workflow and Safety Analysis is required to be prepared by Serco under the Statement of Work ● Damen are procuring all winches and deployment systems through Triplex / RAPP which will ensure an integrated solution from OEM to provide additional expertise to Damen design and engineering team. ● Currently two ex-icebreaker masters are employed by Serco to ensure that knowledge from existing operations can be transferred into the design solution.	● Ensure appropriate internal / external SME expertise is applied to reviewing key design deliverables including but not limited to ENG-410 and ENG-490 ● Project to ensure that Serco continue to focus on operations following design completion and that during the build period the SOPs are developed in good time prior to commencement of operations. ● Serco recruitment of key experienced personnel to ensure a transfer of knowledge in AAD operations.
Science underwater Systems There is a risk that the science underwater systems will not achieve the specified performance due to: ● bubble sweep-down ● noise ● EMI/EMC	● Damen are procuring a significant majority of underwater systems through contract arrangements with Kongsberg reducing the risk of integration related issues ● Statement of Work including model testing and reporting requirements relating to both acoustic noise (propeller cavitation) in addition to bubble visualisation through physical and computational analyses. ● ENG-460 Acoustic Performance Analysis to be presented to demonstrate compliance at the design stage with the underwater radiated noise and sonar self-noise levels.	● Ensure appropriate internal / external SME expertise is applied to reviewing key design deliverables including but not limited to ENG-460. This includes Tim Gates Acoustics. ● A range of full scale testing requirements have been agreed through the contract consisting of sea acceptance trials and special sea trials to demonstrate equipment operation, in addition to full scale acoustic noise measurement in Norway using a naval ship sound range.
EMI/EMC There is a risk that the performance of electronic systems on board the vessel will be reduced or interrupted by EMI/EMC issues.	● The Technical Documentation List indicates that an EMI/EMC Management Plan is planned for submission, which will also be reviewed by Lloyd's Register.	● Ensure appropriate internal / external SME expertise is applied to reviewing key design deliverables including but not limited to the EMI / EMC Plan.

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Technological Change / Obsolescence There is a risk that aspects of the capability defined in the FPS will become obsolete or partially obsolete by the time that the vessel is delivered (ICT / Communications equipment).	● Contract includes provisions that ensure that only new equipment is installed / fitted to the vessel during the D&B Phase ● The Contract is based on a DBOM which means that where equipment selection by Damen leads to potential obsolescence issues during the 10 year initial operating term, Serco will be responsible for managing these issues within their contractual obligations. ● Damen are reporting their procurement activities to Serco / AAD through MGT-120, allowing project to monitor which procurements are yet to be undertaken (providing opportunity for modification / additional cost) where this is very important to AAD.	● Project staff to continually monitor equipment (make / model) selections during the design phase to identify potential obsolescence issues. ● Review of Serco Maintenance Management Plan following completion of design process to ensure that process for management of obsolescence is appropriate. ● Serco have put obligations on Damen to provide specific design deliverables relating to obsolescence (including an Obsolescence Management Plan).