Fairfield Energy Limited, Dunlin Alpha Decommissioning Stakeholder Workshop, 3 May 2018
REPORT

This report forms a record of the 3 May 2017 stakeholder workshop for those who attended the event. It is also intended to help inform other interested organisations and their representatives about the emerging recommendations from the comparative assessment of options for the decommissioning of Dunlin Alpha, and its associated stakeholder engagement.

If you have any comments on the report, or further questions about Dunlin Alpha decommissioning that you would like to raise with Fairfield Energy, please contact Carol Barbone before Friday 15 June 2018 at carol.barbone@fairfield-energy.com. Thank you.

This report has been produced by Resources for Change, a socially responsible consultancy, which independently facilitated the stakeholder workshop on behalf of Fairfield Energy Limited. Additional information has been provided by Fairfield Energy where it is believed that this will enhance understanding of the report content.

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1. Introduction

1.1 Background

The decommissioning of the Dunlin Alpha oil production platform is part of a multi-year, multi-phase decommissioning project being carried out by Fairfield Energy Limited in the Greater Dunlin area. The project follows Cessation of Production (COP) from the area in June 2015, after achievement of maximum economic recovery from the Dunlin oilfields. The 3 May 2018 stakeholder workshop forms part of the stakeholder engagement to inform the decommissioning planning for Dunlin Alpha. Further information about the decommissioning of Dunlin Alpha and its associated facilities can be viewed on the Fairfield Energy website at http://www.fairfield-energy.com/, together with a short, animated overview (scroll down a little and click on the "Watch the Movie" button).

1.2 Workshop purpose

The purpose of the workshop, as set out in advance of the meeting, was as follows:

- To update stakeholders on the progress of the development of decommissioning proposals for the Dunlin Alpha installation, and on the emerging recommendations from the comparative assessment of options.
- To collectively reflect on the work to date, and to identify whether there are any areas of outstanding concern which remain to be addressed, before it is finalised within a formal programme for statutory and public consultation.

1.3 Workshop participation

A list of the stakeholders and Fairfield Energy's Dunlin Alpha decommissioning team who participated in the workshop, along with a list of invited organisations, can be viewed at appendix 1. The design and facilitation of the workshop was carried out on behalf of Fairfield Energy by Resources for Change, a socially responsible consultancy, which specialises in stakeholder engagement.

1.4 Workshop agenda and format

The agenda for the workshop can be viewed at appendix 2.

Fairfield Energy's Dunlin Alpha decommissioning team gave presentations in order to provide context and further information about the topics to be discussed. A copy of the slides used, along with the key points explaining about the emerging recommendations, can be viewed at appendix 3. These cover:

Updates / Background

- **Update on Stakeholder Engagement:** Feedback from the previous stakeholder workshop and involvement in the comparative assessment.
- **Independent Review Group (IRG):** How the group works, its composition and its role.
- **Comparative Assessment (CA):** Overview, mechanics and purpose of the comparative assessment.

Topics for Discussion

- **Emerging recommendation for the Concrete Gravity Base Structure (CGBS)**: The output from the comparative assessment on the CGBS.
- **Emerging Recommendation for the Cell Contents**: The output from the comparative assessment on the cell contents.
- **Other Dunlin Alpha Decommissioning Elements -** those aspects outside the comparative assessment:
    - Topsides removal
    - Drill cuttings
    - Subsea infrastructure programme,
    - Export pipeline (PL5)

The two principal topic presentations (first on the emerging recommendations for the CGBS, and then on the cell contents) were followed by small group, round table discussions (six tables with around 10 people seated at each). The small group format was used to encourage participation and give more opportunity for people to make contributions. Fairfield team members were available for questions of clarification, but were seated separately to ensure that the focus of the round table groups was on stakeholder discussion and comment in the first instance.

Stakeholders were encouraged to consider their reaction to the emerging recommendations from the comparative assessment process, firstly for the CGBS and then for cell contents. For each topic, stakeholders were asked to indicate their level of comfort with each recommendation by populating an evaluation scale, and to give their reasons for this. The evaluation scales and the rationales from each of the small groups were subsequently displayed for the information of all participants. The participants were then asked to identify any key questions or issues concerning the recommendations from their perspective. The main points of discussion were recorded by the facilitation team.

All participants then gathered together in the plenary group for a feedback session, so that the key questions and issues raised in each small group could be shared with everyone present, via facilitator feedback.

The final topic session of the workshop provided an opportunity for all participants to come together and to raise any other questions or issues about the Dunlin Alpha decommissioning not already covered. The main points raised during this session were recorded by the facilitation team.

Fairfield Energy's Dunlin Alpha decommissioning team provided immediate responses to stakeholders' questions whenever possible throughout the workshop sessions. The team committed to come back to stakeholders after the workshop with further information in response to any questions that could not be fully answered on the day.

1.5 Supporting materials

In advance of the workshop at the time of invitation, stakeholders were provided with a copy of *Dunlin Alpha Decommissioning, Comparative Assessment Report, Emerging Recommendations (April 2018)*. This was to give participants and other stakeholders, detailed briefing information about the main topics of the CGBS and cell contents recommendations to be discussed at the workshop. Copies of this report are available on request. The final version of the comparative assessment report will be submitted later in 2018 alongside other key technical documents in support of the Draft Decommissioning Programme, and will be published online as part of the statutory and public consultation. Stakeholders will be notified of this directly.

At the workshop itself, further materials were made available to support the understanding and participation of attendees:

- Printed copies of the studies carried out to inform the decommissioning planning and comparative assessment for Dunlin Alpha. A list of these is provided at appendix 4.
- Two ready-reference briefing sheets, *Dunlin Alpha Fast Facts*, which summarise key data for the CGBS and cell contents. These are included at appendix 5.
- An acronym or *Jargon Buster* handout. This can be referenced at appendix 6.
- Posters that illustrate further detail about the Dunlin Alpha concrete gravity base structure, which comprises cells and legs, and cell contents. Please see appendix 7.

Copies of the slides used to illustrate the presentations on the CGBS and cell contents at the workshop were circulated to participants for use in the small group discussions to stimulate further comment (see appendix 3).

1.6 Outputs of the workshop sessions

A record of the questions and issues raised by stakeholders and the corresponding answers from Fairfield Energy, was made by the Resources for Change team during the workshop. These have been collated and summarised without attribution (in accordance with the ground rules of the meeting agreed with participants) and are set out in the following sections of this report. Additional information from Fairfield in response to the points raised has also been added into the report where it may help to enhance understanding and more fully answer questions raised by stakeholders at the workshop.

1.7 Evaluation of the workshop

The experience of participation in this workshop was evaluated by the stakeholders via a written questionnaire, which was circulated at the end of the event. The feedback has been collated without attribution and can be viewed at appendix 8.

1.8 Future engagement

Stakeholders are invited to submit any further comments or queries to this report, though are asked to do so by 15 June 2018, as Fairfield Energy will need to make progress with the decommissioning planning, including addressing any outstanding stakeholder comments. The final version of the workshop report will be published online shortly thereafter.

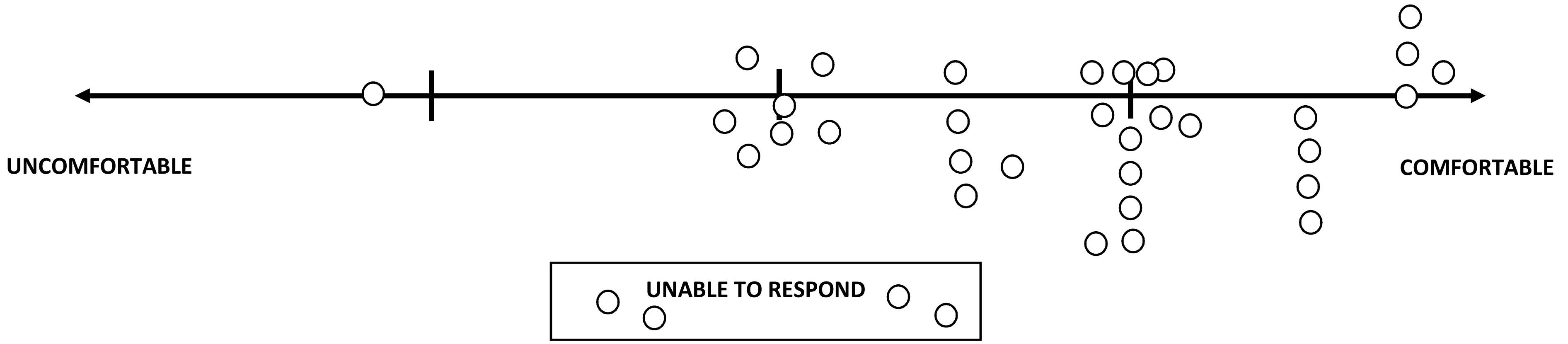
2. Concrete Gravity Base Structure (CGBS) – Emerging Recommendation

This section contains the collated and summarised output from the small group discussion sessions on the emerging recommendation for the Concrete Gravity Base Structure (CGBS) from the comparative assessment (CA) process. Option 9 for the CGBS, to leave the structure in-situ with the transitions up, has been assessed as the recommended option according to the CA evaluation. Information about how the recommendation was reached is set out in the presentation slides and notes, *Concrete Gravity Base Structure Emerging Recommendation*, shown in appendix 3. Fairfield Energy's Dunlin Alpha decommissioning team wanted to establish what level of comfort stakeholders had with the recommendation, and to understand what the questions and issues were behind this response. This was a means to identify what key questions and issues, from the stakeholders' perspective, need to be addressed in order for the recommendation to go forward. A summary of the comments, questions (Q.) and issues raised by stakeholders, and the corresponding answers (A.) from Fairfield Energy, has been collated without attribution. Additional information from Fairfield in response to the questions and issues raised has also been added into the report where it might help to enhance understanding.

EMERGING RECOMMENDATION FOR THE CONCRETE GRAVITY BASE STRUCTURE: OPTION 9, LEAVE IN-SITU WITH TRANSITIONS UP

2.1 The level of comfort stakeholders have with the emerging recommendation

The dots placed on evaluation scales by stakeholders at the workshop, as collated in the illustration below, are intended to give a pictorial impression of the stakeholders' response to the emerging recommendation. The evaluation scales were used to prompt small group discussions about the emerging recommendation at the workshop. Some did not participate in the evaluation scale exercise as it was not appropriate for their role, e.g. regulators and members of the Independent Review Group.



2.2 What makes stakeholders <u>comfortable</u> with the emerging recommendation

2.2.1 Studies and comparative assessment

- Happy with the process that has brought Fairfield to these recommendations.
- Impressed by the work completed by Fairfield since November 2017 and the comprehensive nature of it.
- Confident with the process and its outcomes.
- The work carried out has been transparent and objective. Factors well considered. The use of equal weighting is a good thing.
- The conclusion is reasonable, the methods are well explained and transparent.

2.2.2 Consultation and engagement

- The consultation and engagement has been a good process.

2.2.3 Safety impact

- The structure being visible for many years to come is a significant benefit for the safety of marine vessels and particularly fishermen.
- The presence of a 500m safety zone, due to the structure being left behind, means that the impact (and liability) of any material falling off the structure onto the seabed is negligible, because there is nothing to interact with it.
- I am not concerned about the structure degrading as regards safety, since once it crumbles to a level below the surface, it can be marked with a buoy to make it safe for sea users.

2.2.4 Environmental impact

- Most of the material of the CGBS that will be left behind is steel and concrete and therefore negligible in terms of its environmental impact.
- There will be less impact on existing marine life with this option.
- This option produces less environmental damage, especially in terms of landfill and on-land processing.
- A downside to this option is not applying 'one planet economy' thinking and not recycling all the materials – but how would you do that, as bringing ashore is not really an option, so it is better to leave it out there rather than distributing waste all over the country.
- Bringing the structure ashore raises the issues of contamination and noise as well as 'waste leakage' and taking up capacity of the waste management infrastructure on land.
- There are likely to be difficulties with having the waste material accepted into port were the structure to be removed and brought onshore.
- Overall CO_2 considerations in the comparative assessment would not change the outcome but would support the final choice.

2.2.5 Economic impact

- The UK tax payer will be picking up a lot of this bill. So important factors are whether the money used for decommissioning could be spent differently, and whether decommissioning is the most effective use of resources.

2.2.6 Technological development

- The structure will eventually break down to the sea bed level over 500 years, and if not, technology is likely to have developed to enable it to be taken down.
- Happy with the option as is. In the future things may change with technological advance and make full removal or other options possible, but we cannot really assess that at this stage.

2.2.7 Public perception

- Public concerns are likely to focus on onshore disposal costs and not wanting waste to come on land near them, and the potential increase to fuel costs to 'pay' for the decommissioning.

2.3 What makes stakeholders uncomfortable with the emerging recommendation

2.3.1 Liability in perpetuity

Stakeholder Question / Issue	Fairfield Response
Q. Operators retain liability in perpetuity for the structure left behind and what is the economic consequence of that? Was this included in the comparative assessment? Who would be responsible in the longer term for this liability? Do operators need to place a bond with the government? What is the approach? The industry has not addressed this issue yet. Q. Who will be responsible for the ultimate fate of the structure?	A. *See section 2.5.1 below on liability in perpetuity.*
Q. There needs to be clarity or further information on what aspects of the structure left behind would actually constitute a liability. For example, if pieces of the structure drop off and fall on to the seabed, whether this would this be classed as dumping given that it would not be a deliberate act. Would it require removal? Or whether there is any requirement ongoing to recover any material that falls onto the sea bed within the 500m safety zone. And what happens when the structure degrades below sea level, whether the safety zone stays in place, and if not, whether there would be any requirement to retrieve material falling onto the sea bed.	A. For the purposes of the Comparative Assessment (CA) process, Fairfield has assumed that material ultimately falling to the seabed in the immediate vicinity of any derogated structure would not require to be recovered. With regard to a safety zone, the CA sensitivity analyses which Fairfield have conducted would suggest that the presence or otherwise of a safety zone is not a significant factor in the overall evaluation of options. Fairfield will continue to discuss the future status of the safety zone with the relevant regulatory bodies in order to bring further clarity on this topic.

Q. Is this option just passing the buck for, say, 250 years? If there was a future requirement for removal once the structure starts to degrade, decommissioning might be an even more difficult task (e.g. technical, safety) at that time. Q. I am concerned that there may be future safety implications for sea users when the structure degrades that need rectification, and what the cost implication of that would be.	A. As stated during the workshop, the derogated options are not presented or portrayed as interim solutions. For those options where part or all of the substructure remains in situ, Fairfield has assumed that there would be no future attempt to completely remove the substructure. If derogated, the substructure will degrade in situ over time and this is the ultimate end state. Rectification is not envisaged. The future safety implications for others users of the sea has been addressed in various studies, primarily in terms of legacy collision and snagging hazards. These legacy risks have been found to be extremely low when compared to any commonly used risk acceptance criteria.
Q. There is a strong argument for leaving the structure in situ, but this is not necessarily the regulatory view. There is a possibility that the legs will have to be removed within the foreseeable future to -55 LAT because it is anticipated that the OSPAR regime will tighten the derogation case as technology develops. The technology must be on the horizon for it to have been included in the comparative assessment. An Independent Review Group (IRG) that recently reviewed another operator's plans for CGBS, highlighted this issue and also recommended that a joint industry project be undertaken by CGBS owners to advance the technology. I would like to know if these conclusions have informed the CA process. If it is likely that removal would be required at a later time, and considering the diminishing structural integrity, associated cost (which includes cost to the taxpayer) and safety issues, how has this informed your thinking? Q. Potential changes to regulations in future may change removal expectations and therefore incur large future costs.	A. We have been informed by other operators' work and experience past and present. We are familiar with the Shell Brent project and that of other operators. The International Association of Oil and Gas Producers (IOGP) has a working group in which Fairfield has been involved, that has been looking at some of the issues you mention. One IRG's assertion on one project is not necessarily the case overall. The options presented are not interim recommendations awaiting technological solutions, these are the recommendations we expect to go ahead. It behoves us to be honest about that. However, this does not preclude technological improvement. Technology might improve to make removal easier, but it may also may improve navigation aids so that removal is less of a requirement. Over time structures will degrade, but there are only a handful of CGBS, and our studies have shown it is a very small hazard to sea users overall in the long term and compared with removal risks. We are confident that what we propose is the best solution. We are trying to be transparent about our evaluation process and explain it in an accessible way.
Q. The structure will not be there for ever and so what is the future legacy risk? Sooner or later it will start to collapse and so who takes responsibility for this in the long term, especially if it does not all happen as predicted. What happens if the company disappears or goes bust? Q. How well do residual and monitoring liability in perpetuity actually work in practice? It is imposed by the government but is it realistic?	A. Fairfield and its joint venture partners are Section 29 notice holders and have immediate responsibility. But there is a list of others (previous licensees) which have had a stake in the asset over its lifetime. The responsibility would devolve to them if Fairfield was no longer in existence. The details of the monitoring regime for the derogated substructure are still to be developed in detail, but they would be risk based and each monitoring exercise would inform the need and timing for subsequent monitoring. There are already derogated structures in the North Sea which have such programmes in place and they appear to be working as intended. As described above, Fairfield, its joint venture partner, Mitsubishi, and potentially any other Section 29 notice holder are responsible for the long-term liabilities. The UK

Q. Who is responsible and how for long-term legacy and liability? How does it work within international law issues; Fairfield is owned by Mitsubishi, so does the decommissioning responsibility come under international law?	authorities have served those notices on the legal entities they deem appropriate. It should be noted, for clarity, that Mitsubishi does not own Fairfield or its affiliates as the question would suggest.

2.3.2 Comparative assessment criteria and weighting

Stakeholder Question / Issue	Fairfield Response
Q. Why was an even 20% spread selected for the criteria weighting in the comparative assessment. What alternatives were considered? Q. Is the equal weighting used for the criteria and sub-criteria in the comparative assessment good practice? Is it demonstrably good practice? Where has that methodology come from? Will it stand up to public scrutiny?	A. *See section 2.5.2 below on criteria weighting.* A. The criteria and sub-criteria considered in this Comparative Assessment were taken from the DECC (now BEIS) Guidance for the Decommissioning of Offshore Oil and Gas Installations and Pipelines. In terms of the three potential evaluation methods outlined in the guidelines, it was decided to use Evaluation Method C, which is the most onerous method. This method was selected due to the complex nature of the CGBS and cell contents decisions, and the desire to provide a robust, transparent and auditable decision-making process. We believe it allows stakeholders to assess the relative advantages and disadvantages of each option against each of the other options, and to rank these accordingly. Fairfield would contend that this is demonstrably good practice.
Q. Is there such as thing as carbon neutral decommissioning? Would an option be rejected just on CO_2 emissions? Probably not, although having the same 20% as all other aspects may be over-cooking it. Note that in terms of onshore disposal, CO_2 is not considered and may be underestimated, for example in terms of disposal of 80,000 tonnes of iron ore.	A. No criterion or sub-criterion was intended to act as a singular reason for rejection of an option. CO_2 emissions, considered alone, would therefore not cause any option to be rejected. It should be noted that emissions did not constitute 20% of the evaluation. The Environmental criterion also includes operational marine impacts and legacy marine impacts. Emissions and energy consumption therefore attracted a weighting of 6.66%, not 20% as suggested by the question. With regard to onshore disposal, CO_2 emissions were not viewed as a likely key factor in the evaluation, given the significant emissions associated with the offshore scopes.
Q. The legacy of this option could be 300 years in future, so how long-term are the environmental and societal costs that have been factored into the CA? How has this length of time been allowed for within the criteria and weighting? How can we cost and model long term? To what extent has long as well as short term been considered?	A. Much of the study work which supports the CA addresses the long-term fate of the substructure and its contents. Longevity studies on the legs and base caisson, for example, have looked millennia into the future. The treatment of legacy costs, under the Economic criterion, has been based on a lesser time horizon (typically 50 years) due to the present value of cash flows beyond that time being small in comparison to execution costs. In practice, we have also conducted a sensitivity analysis on each recommendation whereby all costs have been disregarded. The recommendations have been found to be robust under this sensitivity.

Q. I am satisfied with the criteria but would the results have been different if fishing was evaluated under the societal criteria rather than safety?	A. The impact on fishing was evaluated in two distinct ways. The legacy safety risk to fishermen was evaluated under the Safety criterion, and the commercial impact on fisheries from each of the options was evaluated under the Societal criterion. So in fact, both aspects have been evaluated and factored into the recommendation.
Q. Why was anthropogenic noise selected as one of the main environmental evaluation criteria, since most of the noise from removal would be from underwater cutting which is relatively insignificant? What else was considered?	A. It is a requirement that noise is one of the things considered, along with emissions, under environmental impact as part of the CA process. Vessels have a much greater impact than cutting in relation to noise. Marine releases were also considered, as were marine operations, e.g. disturbance of drill cuttings, removal of cell contents, and legacy impact such as disturbance to sea bed and releases. There are sub-criteria under the main criteria.
Q. What are the key implications of the recommended option in terms of each of the five CA criteria?	A. It is difficult to summarise the implications of the recommended option succinctly in this Q&A section. In brief, the recommended option is the safest in terms of execution risk and risk to other users of the sea (both during execution and into the future). It is the least impactful from an environmental perspective (marine, emissions and energy consumption). It is technically achievable, whereas other options carry various degrees of technical risk. It does not create a significant number of jobs, nor does it restore the area to unencumbered fishing (as the full removal option might do) but it does have a very significant cost advantage over the full removal case. The implications will be addressed fully in the consultation draft Decommissioning Programme and the accompanying Environmental Appraisal.

2.3.3 Structural degradation and long-term fate

Stakeholder Question / Issue	Fairfield Response
Q. What is the phasing of the degradation, as the protection diminishes, first the anodes, then the interface, the protection of the CGBS would gradually go. Where is this information set out? Q. What is the ultimate fate of the structure; what happens 20, 100, 500 years hence? Q. It would be useful to have a better understanding of how the underlying structure will last or degrade. Q. When and how will the collapse of the structure happen?	A. *See section 2.5.3 below on long-term fate.* In brief, for the purpose of carrying the Aid to Navigation, additional protection will be provided for the transitions to increase longevity to around 200 years. The upper sections of the concrete legs are expected to remain in situ for 200-300 years and around 1000 years for the lower sections of the legs. The roof sections of the base caisson should last around 1400 years. The degradation is expected to take the form of spalling (a gradual deterioration and crumbling) rather than large sections of the substructure falling. The deterioration of the upper parts of the legs is therefore expected to have a limited impact on the lower sections of the substructure.

Q. What are the levels of uncertainty on the assumptions made in relation to how and when the structure will start to collapse, the remaining oil will be released, etc.? Q. What is the timescale of the degradation? Models exist, but do we really know?	A. There is some degree of uncertainty in any technical work, but the Dunlin Alpha substructure is a well-known and understood entity. The structural studies which support the CA are based on both sophisticated modelling and more than forty years of operational experience and inspection activity. The degradation timescales indicated above are believed to be realistic, technically-grounded estimates.
Q. The anticipated life of the legs is 250 years; therefore transitions need to match current engineering.	A. As outlined above, the emerging recommendation would include additional corrosion protection to the steel transitions for the purpose of carrying the Aid to Navigation. Beyond 200-300 years, it is anticipated that the concrete legs will fail and the substructure will be below surface.
Q. When the legs fall down eventually, what will be the effect on the cells?	A. The legs will not collapse in their entirety but will instead gradually degrade due to spalling of the concrete. This will happen over a very long time scale, centuries to millennia. There is no collapse scenario that would result in the full residual mobile inventory being released instantaneously, instead this will be a gradual release as new communication paths open up in the structure. The size of these releases will be so small that the oil will very rapidly disperse and no intervention would be required.
Q. Can mitigation happen now for future benefit, such as the creation of a reef around the platform which will also help protect it and into which it can collapse when it eventually does?	A. The project has not considered the creation of a reef, which would presumably necessitate the introduction of new foreign material to the site. We are not aware of how such an undertaking would 'protect' the substructure, which will ultimately degrade due to corrosion mechanisms within the structure.
Q. In the event of an earthquake what would be the impact on the legs without the topsides, will extra support be needed? *Stakeholder clarification:* I understand that each of the legs are a structure in their own right and not dependent on the module support frame.	A. *See section 2.5.4 below on seismic activity.*

2.3.4 Maintenance

Stakeholder Question / Issue	Fairfield Response
Q. How long will the added protection on the concrete legs last?	A. The emerging recommendation does not include added protection on the concrete legs. It does include corrosion reduction measures on the steel transitions of the substructure through the splash zone. It is anticipated that such measures will extend longevity to over 200 years.

Q. A maintenance element has been introduced. Anodes are to be introduced to give protection to the structure. Anodes degrade. When the anodes need replacement, there is a difficulty in operating in a tidal zone, especially with a deteriorating structure. Vessels would not be prepared to do it. What has been planned? Will there be maintenance ongoing? Q. What maintenance issues are there with extending the anodes to the transitions?	A. There is no need for ongoing maintenance of the cathodic protection installation. The sacrificial anodes can be placed in sufficient quantity and mass to obviate any need for their replacement.
Q. I am concerned about safety sea users and the Aid to Navigation. What are the arrangements around that? Who will maintain it and for how long? Fairfield said they would maintain the Navaid for as long as the integrity of the structure allowed, so how do you prevent an accident after that?	A. The Aid to Navigation will have a four-year change out programme with the change-out performed by helicopter. Commercial arrangements for this programme have not been finalised, but such arrangements are already in place on other derogated structures in the North Sea. An aerial inspection of the legs will be done at the same time to assess what degradation has occurred. The longevity of the upper sections of the substructure will be in the order of 200 years. Beyond this time, it is thought very unlikely that navigation will rely on present-day technology of a flashing light to mark the substructure. It should be noted that Admiralty Charts and FishSAFE will also be marked appropriately.
Q. What is the maintenance commitment and who will pay the cost? Is there a legacy arrangement? Q. Who pays for the Navaid? Q. There was mention of a 50-year period. Whose responsibility will it be to manage the maintenance e.g. who will replace the Navaid, if necessary?	A. The Decommissioning Programme will address the management of legacies and liabilities. It is envisaged that there will be the maintenance programme for the Aid to Navigation and a requirement for periodic inspection and monitoring of the substructure. As described above, commercial arrangements will be put in place for conducting these future activities. The associated costs will be borne by the current owners.
Q. Does the residual liability in perpetuity obligation extend to maintaining the Navaid? What happens if Fairfield disappears as a company? Q. Who will be maintaining the Navaid in the long-term, because a corporation probably would not exist many years ahead?	A. The responsibility lies in perpetuity with the company or companies that own the derogated substructure. The companies who may potentially carry such a responsibility have been served Section 29 Notices to this effect. The question of commercial arrangements for Navaid maintenance has been addressed above.

2.3.5 Cell contents

Stakeholder Question / Issue	Fairfield Response
Q. No methodology was shared about how the cell walls would be flushed. There may be some corrosion in the long term, or there could be a seismic or other event, and these cells contain oil. Option 9 needs to include a requirement for cleaning the cells as an environmental consideration.	A. The management options for the residual cell contents was included in the afternoon discussions and addressed by the project as a separate nested decision point (see section 3 below). The Environmental Appraisal summarises the environmental considerations if the structure and its contents are left in situ as per the emerging recommendations.
Q. Has enough work been done, including samples taken, about cell contents to fully inform and justify the recommendation on the CGBS? The feedback and objections from stakeholders remain to be seen in relation to the cell contents. This is an unknown.	A. *See section 3.4.3 below on sampling and validation.*

2.3.6 Safety impact

Stakeholder Question / Issue	Fairfield Response
Q. Managing safety for sea users into the future is a concern with this option. If due to degradation the upper sections of the legs crumble as far as the splash zone, they would be unseen from the surface, but will not have degraded low enough to be missed by shipping.	A. The longevity of the upper sections of the substructure will be in the order of 200 years. Beyond this time, it is thought very unlikely that navigation will rely of current day technology of a flashing light to mark the substructure. The project team has engaged Northern Lighthouse Board on these far-future issues and believe that navigation technology will advance significantly in the intervening centuries.

2.3.7 Derogation uncertainty

Stakeholder Question / Issue	Fairfield Response
Q. The OSPAR response to the Brent derogation application is not yet known, so the likely OSPAR reaction to Dunlin Alpha is uncertain.	A. There is inherent uncertainty is any regulatory or pseudo-regulatory process. OSPAR's reaction to another installation's derogation application would not be viewed as a precedent in either direction. The case for derogation of the Dunlin Alpha substructure must be satisfied in its own right.
Q. Once the decommissioning decision has been made, will it stand? Something may happen further into the future, for example with an OSPAR revision to derogation requirements.	A. While regulations, guidelines and international treaties may change, the changes are seldom applied retrospectively. Fairfield would hope that any regulatory decision made in good faith would be honoured.

2.3.8 Social responsibility

Stakeholder Question / Issue	Fairfield Response
Q. Oil and gas companies put this structure in the ocean; should they not do more?	A. The decommissioning of the Greater Dunlin Area will cost many hundreds of millions GBP. We believe we are acting responsibly by carefully plugging the wells to isolate the reservoirs and removing much of the associated facilities, both subsea and topsides. To do more, we would be choosing a less safe, more environmentally impactful, technically challenging and costlier option with little upside.
Q. Will future generations condemn us?	A. We believe we are proposing the optimum solution for the Dunlin Alpha substructure when all factors are considered.

2.3.9 Public and stakeholder perception

Stakeholder Question / Issue	Fairfield Response
Q. The OSPAR regulation of 'clear seas' is not being adhered to, so will the perception of the "man in the street" be that rules are being broken / bent?	A. It is clear that OSPAR Decision 98/3 recognises that decommissioning in situ may be the best alternative for certain types of structure. We would contend that no rules are being broken or bent if a derogation is sought and approved under the criteria set forth in Decision 98/3.
Q. Will this option be likely to be challenged by environmental groups, as at Brent Spar?	A. It is for NGOs to speak for themselves and we cannot predict other's perspectives. We have engaged a range of environmental groups as part of our stakeholder engagement activities and a number of notable organisations were invited to this workshop. Unfortunately they were unable to attend due to other commitments.

2.3.10 Method statement

Stakeholder Question / Issue	Fairfield Response
Q. Why not leave up one transition only for the Navaid and cut the other three?	A. *See section 2.5.5 below on the method statement.*
Q. A concern that the Navaid may be difficult to attach.	A. There should be no technical challenge. Navaids are already deployed on derogated structures and are changed-out by helicopter without incident.
Q. Unclear about the lower conductor section – will it be left in situ and why?	A. While the well plug and abandonment activities are well in progress, no conductors have yet been removed. Many of the conductors have had clamps and sleeves retrospectively installed for integrity purposes. These now make the pulling of the

Q. Can there be more information / clarity about what will be done with the conductors and conductor guide? Q. The issue of the conductor guide frame removal was not clear – how will this be done, and when, as the diagram shows them reduced in size?	conductors through the guide frames technically challenging. Fairfield is exploring new technologies to assist with this scope but there is uncertainty on what can be achieved. The current intent is to remove the top three sections and leave the lowest section in situ. The lowest section would be left in situ to avoid disturbance of the drill cuttings.
Q. Not clear what arrangements there will be for a safety zone with the recommended option, including how big the zone will be?	A. The project has a working assumption, tested with regulators, that where a substructure pierces the surface, there will be a 500m safety zone marked on charts. We are aware that this is an area of ongoing debate across industry, but we have applied our working assumption and then conducted sensitivity analyses to (i) remove and (ii) impose safety zones on all derogation options. The CA evaluation was found to be insensitive to this assumption.

2.4 Other points raised

2.4.1 Industry efficiency

Stakeholder Question / Issue	Fairfield Response
Q. Do we need to go through a CA process every time for every structure? For example, there are similarities with the Brent CBGS. A CA evaluation has been done for the Brent CGBS and, although the context is different, the same conclusions were drawn.	A. *See section 2.5.6 below on industry efficiency.*
Q. Has there been any learning about the process from Brent and therefore been able to save time here?	A. As a responsible operator, Fairfield has sought (as well as shared) lessons learned with operators and other stakeholders. Some of these learnings have been process related and some have been technical in nature. In the case of the cell contents, we have drawn upon learning from a wide range of projects, including Brent, Ekofisk, Maureen and Siri. We have adapted our inventory evaluation strategy to improve our level of confidence of not only the understanding of what is left within the cells, but where it is likely to be located.

2.4.2 Economic benefit

Stakeholder Question / Issue	Fairfield Response
Q. Any money that is spent on decommissioning should be spent up here (Scotland / Aberdeen).	A. The sentiment behind the comment is understood, and Fairfield was pleased to award its subsea decommissioning scopes to a consortium which includes the Port of Cromarty Firth; a significant first decommissioning contract for that area. That said, there are certain rules which prohibit the exclusion of other areas/countries from competitively tendering for work.

2.5 Key questions or issues to be addressed

The following points were selected by the table groups as significant to feed back to the plenary session.

2.5.1 Liability in perpetuity

Stakeholder Question / Issue	Why it is important	Fairfield Response / Where it is or will be addressed
Q. Has the matter of the company's liability in perpetuity for the structure been adequately addressed in the comparative assessment, including the cost of the liability and the associated financial arrangements? Liability issues that might arise are technological development and the tightening of OSPAR regulation, which then require the option to be revisited and further work done, or fallen debris which require removal from the sea bed.	Liability is seen as a key contingency and aspect of uncertainty of the recommended option by some stakeholders, and one which may make the option less preferred or comfortable.	A. The matter of longevity and liability has been explored through the study work and comparative assessment, and is understood. The maintenance burden of the Navaid has been assessed and costed. To inform the approach for monitoring the remaining substructure, Fairfield has undertaken discussions with other operators who already have experience of doing so, and a programme will be agreed with the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED). Retrospective application of regulatory changes is considered unlikely. Liability in perpetuity is something that the whole industry will need to address going forward. There will be a need for innovation. There is the potential that the supply chain may offer some solutions in the form of an insurance mechanism, or that trust companies might be set up. The eventual transfer of liabilities from private companies to the government is another possibility. *An opportunity for this topic to be discussed further one-to-one over during the lunch break was offered by Fairfield to those stakeholders with a particular interest in the matter.*

2.5.2 Comparative assessment weighting

Stakeholder Question / Issue	Why it is important	Fairfield Response / Where it is or will be addressed
Q. Why was an even 20% spread selected for the criteria weighting in the comparative assessment. What alternatives were considered?	The public might give more weight to societal factors (it was also recognised that environmental groups would	A. Consideration was given to the weighting used. The 20% weighting for each of the five criteria is a standard approach used in comparative assessment. In addition to

	want to see more weighting given to environmental issues).	the weighting, Fairfield also used sensitivity analyses in the comparative assessment to test the robustness of the options. Using a 20% allocation made the comparative assessment evaluation more straightforward and understandable. If different weightings were used for each of the criteria, clear justification would be needed. It would make the comparative assessment approach more difficult to explain to stakeholders. There is no value in over-complication for the sake of it.

2.5.3 Long-term fate

Stakeholder Question / Issue	Why it is important	Fairfield Response / Where it is or will be addressed
Q. What is the ultimate fate of the structure and when, and what are the implications of that?	This aspect of Fairfield's study and evaluation work is essential to fully understanding what the option involves.	A. Additional protection will be provided for the steel transitions at the top of the legs. This should increase their longevity to around 200 years. The upper sections of the substructure's legs are expected to remain for 200-300 years and around 1000 years for the lower sections of the legs. The roof sections of the base caisson should remain for around 1400 years. The degradation is expected to take the form of spalling (a gradual deterioration and crumbling) rather than large sections of the substructure falling. The deterioration of the upper parts of the legs is therefore expected to have a limited impact on the lower sections of the structure.

2.5.4 Seismic activity

Stakeholder Question / Issue	Why it is important	Fairfield Response / Where it is or will be addressed
Q. How secure and stable would the remaining structure be in the event of a seismic occurrence, and is further stabilising of the structure needed for this purpose after the topsides are removed?	If the structure is to be in place in the longer term amounting to 100s of years, then the perception is that events of this kind of event become a more likely occurrence and a higher risk. If a seismic event were to affect the legs, there is potential for more dramatic degradation, i.e. large pieces of the leg falling off, rather than spalling, and therefore more likely to impact on the integrity of the cells.	A. The factor of seismic activity will have already been accounted for in the design of the structure when it was first constructed. Furthermore the North Sea is an area of low seismic activity. Wave energy and extreme environmental events in the North Sea would be the main factors of stress on the remaining structure. The stiffness of the structure can be an issue in the case of seismic activity, but since the topsides of Dunlin Alpha are going

		to be removed, this is not a concern. Weight is removed with the topside, and this reduction in mass would actually reduce any risk posed by an earthquake.

2.5.5 Method statement

Stakeholder Question / Issue	Why it is important	Fairfield Response / Where it is or will be addressed
Q. Why not leave up just one transition and cut the others, rather than leaving all four in place?	The company should do what it can to reduce the risk of the transitions falling whole and impacting on the cells. The recommended option involves relatively little action compared with the other options evaluated, and the company should remove what material it is able to.	A. There is a significant level of technical risk associated with the shallow cut to this part of the leg. The approach would be to undertake the cut in a single pass. This has never been done before. It is potentially possible, but it would be challenging. If it were to be successful however, this would then leave three submerged hazards as the concrete legs do not reach as far as the water level. There is some expectation that technology will develop, whereby the need for Navaids on structures like Dunlin Alpha will become less of a necessity. At the present time, the approach of leaving legs with the transitions in place so that they protrude above the water, and the provision of one Aid to Navigation seems to be the optimal solution.

2.5.6 Industry efficiency

Stakeholder Question / Issue	Why it is important	Fairfield Response / Where it is or will be addressed
Q. Do we need to repeat this process and research over and over again, or have we reach a point where we have enough information now for this not to be needed (an industry-wide question)?	The studies and CA involve a lot of work. Is time, money and effort being spent without adding real value? Is there an opportunity to improve efficiency across the industry?	A. We appreciate that stakeholders make time to engage about the Dunlin Alpha project and have given commitment to the process. However, Fairfield recognises that, as an industry, there is the danger of stakeholder fatigue. We need to be careful not to develop specialisms in comparative assessment methods. There should be limits to its sophistication. It should be done in a straightforward, repeatable way. Dunlin Alpha is unique however, so in this case, a tailored approach for the structure has been appropriate. This should be the exception rather than the norm, especially when involving stakeholders.

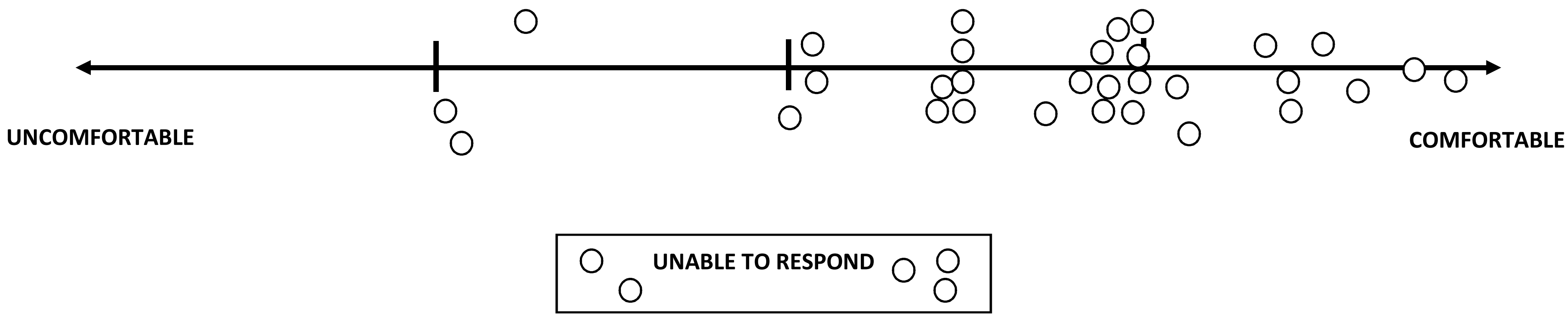
3. Cell Contents – Emerging Recommendation

This section contains the collated and summarised output from the small group discussion sessions on the emerging recommendation for the cell contents from the comparative assessment process. Option 4 for the cell contents, to leave the contents in-situ without recovery or treatment, has been assessed as the recommended option according to the CA evaluation. Information about how the recommendation was reached is set out in the presentation slides and notes, *Cell Contents Emerging Recommendation*, shown in appendix 3. Fairfield Energy's Dunlin Alpha decommissioning team wanted to establish what level of comfort stakeholders had with the recommendation, and to understand what the questions and issues were behind this response. This was a means to identify what key questions or issues, from the stakeholders' perspective, need to be addressed in order for the recommendation to go forward. A summary of the comments, questions (Q.) and issues raised by stakeholders, and the corresponding answers (A.) from Fairfield Energy has been collated without attribution. Additional information from Fairfield in response to the questions and issues raised has also been added into the report where it might help to enhance understanding.

EMERGING RECOMMENDATION FOR THE CELL CONTENTS: OPTION 4, LEAVE IN-SITU

3.1 The level of comfort stakeholders have with the emerging recommendation

The dots placed on evaluation scales by stakeholders at the workshop, as collated in the illustration below, are intended to give a pictorial impression of the stakeholders' response to the emerging recommendation. The evaluation scales were used to prompt small group discussions about the emerging recommendation at the workshop. Some did not participate in the evaluation scale exercise as it was not appropriate for their role, e.g. regulators and members of the Independent Review Group..



3.2 What makes stakeholders comfortable with the emerging recommendation

3.2.1 Studies and comparative assessment

- A lot of technical work has been done, which is impressive.
- There has been significant study work undertaken on the cell contents.
- Feels like the study has a good balance between safety, economy and environment.
- The studies, options and rationale presented were comprehensive and conclusive.
- Impressed with the work completed since last November, and also with the comprehensive nature of that work.
- Happy with the process that has brought Fairfield to these recommendations.
- A considered, rigorous process has been undertaken by Fairfield with the studies and consultation.
- All the other options have been thoroughly explored and the recommended option is as far as it is possible to reasonably go in the current context.
- Overall this is the ‘best worst option’.

3.2.2 Environmental impact

- No immediate environmental impact.
- To leave the cell contents alone is the best option with the least impact.
- Leaving the cell contents in place will have the least impact on environment.
- There is 1500m^3 of mobile oil remaining but which, if /when released, would disperse and dilute over a long period. We are told that previous experience shows that the environment can cope with this, so this is accepted.
- The cells themselves will last for 100s of years and so there is no immediate environmental concern about the contents.
- The environmental gain against other costs seems reasonable for this option.
- The impact on the ecology / environment is miniscule so feel the results / decisions are fine so long as there is nothing unexpected.
- Carrying out work would create seabed damage and damage to existing sea life.

3.2.3 Drill cuttings disturbance

- There is a residual risk from the drill cuttings and the industry recognises that these are best left alone.
- The cuttings pile and carrying out work that would disturb this is a big challenge.

3.2.4 Safety impact

- There are further implications in terms of increasing risk if we look at further removal.
- Leaving the cell contents in place will have the least impact on safety.

3.2.5 Limits of current technology

- Removal will do more harm than good with current technology.
- It is the best option given the existing knowledge and technology available.
- It is a pragmatic option in the current time with current technology.
- In-line with current technology constraints.

3.2.6 Technological development

- There are legacy risks, however, there is a long period of grace before the structure would degrade, and in which time technical advances are likely to emerge to deal with those issues.

3.2.7 Regulatory process

- There is the security of the derogation process through OSPAR, which means that the situation will be monitored and can be reviewed in the circumstance of any technological advance, and can be revisited and dealt with later if feasible.

3.2.8 Cost-benefit

- The time, effort and energy used to go in again and get the little oil left in the cells, compared to natural degradation over time, makes removal the least favourable option environmentally, as well as the issue of diminishing returns for increased effort.

3.2.9 Social responsibility

- As a society we need to ‘grow up’ about these issues. If we want the benefits of energy then we have to accept that there is some impact or consequence, but we have an obligation to learn from what we have done previously and to improve practice.

3.3 What makes stakeholders <u>uncomfortable</u> with the emerging recommendation

3.3.1 Environmental evaluation

Stakeholder Question / Issue	Fairfield Response
Q. What would be the environmental cumulative impact of contents released from several decommissioned platforms? Q. What is the combined impact of the decommissioning of so many oil fields? How is this being assessed and allowed for in terms of cumulative impact? Q. Whatever happens here could set a precedent for the future. Concerned about the effect of multiple instances from across the industry; there are 27 concrete bases, and what would happen if there was a catastrophic loss across all 27?	A. *See section 3.4.1 below on cumulative impact.* A. Not all the concrete bases were designed with or utilised the bottom compartments for oil storage. This significantly reduces the number of facilities with potential for residual inventory. Coupled with this, each has different design features and integrity status that may increase the ability to recover the contents. The likelihood of an instantaneous release (due to a high impact event) is low. The probability of this happening at the same time across multiple facilities is even lower.
Q. What is the level of uncertainty of an instantaneous release of contents from the cells and what would be the impact on the food chain? Q. What is the environmental impact of an instantaneous release? How will release occur?	A. We have evaluated the scenarios that could initiate instantaneous release and think that only three or four cells could possibly release at the same time. Therefore, we have revised calculations based on 4 cells releasing their contents (taking a conservative view). In such a scenario it is not physically possible to release a high enough concentration of any individual component from the cell for it to be an issue. The environmental impact of the release of the cell contents has been assessed as minimal, with no significant beaching of oil or bioaccumulation effects.
Q. Is there any evidence or information about the comparative environmental impact of accidental release now, versus when there is release because of degradation later on?	A. *See section 3.4.2 below on environmental evaluation.*
Q. What would the impacts on marine species other than humans be?	A. A source-receptor-pathway analysis has been undertaken; a summary of this is included in the posters on display at the workshop (see appendix 7). It is also covered in more detail in Chapter 5 of the Cell Contents Technical Report and will of course be addressed in the Environmental Appraisal report.
Q. Has there been a survey of what marine organisms there are in the cuttings pile, and is it better to leave it there for biodiversity?	A. Extensive surveys have been conducted for the cuttings pile. Marine organisms have been found in the cuttings pile, but nothing rare or endangered.
Q. Where there are drill cuttings, the volumes seem very large, so why didn't their presence make more difference to the results?	A. In evaluating the long-term management option for the cell contents, we wanted to ensure that the assessment did not treat the drill cuttings as a barrier to entering the cells. It is important that the cell contents decision stands on its own merits and the

	drill cuttings are not seen as an excuse to do nothing. We therefore performed a sensitivity analysis assuming that there was no presence of drill cuttings. This showed that, even without considering drill cuttings, the most preferred option on balance is to leave the cell contents in situ.
Q. Quite large volumes of water phase are left. What's the oil concentration? How oily or not is it?	A. The system must be kept completely liquid filled, to maintain a stable pressure. This water will have low concentrations of dissolved hydrocarbons and metal components. The inventory estimates that on average there is an oil-in-water content of around 40mg/l. Note that the concentration is variable across the cells and will be higher in those with more sediment and wall residue contamination.

3.3.2 Sampling and validation

Stakeholder Question / Issue	Fairfield Response
Q. Has any real (i.e. physical as opposed to modelling) work been done on the legs content and the residue within them? Q. Is there real evidence and knowledge of how much oil is inside the cells?	A. *See section 3.4.3 below on sampling and validation.* A. The amount of oil left within the cells has been determined based upon the physical evidence of how much oil was extracted from the cells during the Attic Oil Recovery Project (AORP). This has been further validated using a detailed dynamic model which replicated the pumping records of the oil extraction activities.
Q. If it is all left in place, it would be good to infiltrate the cells, especially the ones with cuttings on top, to investigate and verify actual contents and what is in the sediments. Q. How much real evidence is there? Feels like it is all based on modelling. Q. The potential for sampling (of cell contents) was mentioned – how would this fit with the emerging recommendation if the results are not as expected?	A. The uncertainty in the inventory basis has been assessed and taken into account during the Comparative Assessment for the long-term management options. The inventory has also been created on a cell-by-cell basis to assist with understanding variability in data should physical survey/sample information be obtained. If future data is obtained that does not align with the expected variation/uncertainty, or fundamentally contradicts the basis for the inventory, the decision for how best to manage the cell contents would need to be revisited.
Q. Is sampling the cells via the cell top access feasible and viable? Q. Why is the original pipework hard to use? Is it really that difficult?	A. This has been demonstrated as technically viable by Shell on their Brent Delta platform. A. We have investigated a number of options of accessing via the existing pipework. The most feasible is to go through the rundown lines (which enter into one cell of each of the original four oil storage groups), however these lines were taken out of service in 2007 due to integrity concerns. One is mechanically isolated, and therefore inaccessible

	other than the potential to extract a water sample. We have been progressing engineering to access at least one of the three remaining with a micro remotely operated vehicle (ROV). This presents challenges in navigating the bends in the pipework; the presence of inhibitor gel and waxing of the lines may also hamper navigation. Our primary concerns are safety related, with the potential for a loss of containment due to pipework breach, and the discovery of very high H_2S concentrations when trying to vent off trapped pressure in the pipework. At the present time, the option to physically access the cells via the rundown lines is on hold until the mechanisms for pressure evolution and H_2S are better understood, and management procedures put in place to ensure the safety of personnel working in the leg.
Q. Why did none of the options include sampling of the cells?	A. The options for survey and sampling of the cells is addressed in the Cell Contents Technical Report, and they form part of the inventory validation strategy as set out in Chapter 3 of this document. The Comparative Assessment focussed on the long-term management options using the inventory base case as a primary input to the evaluation.
Q. How do we know that the modelling is reasonably accurate if Fairfield haven't done any sampling?	A. The base-case inventory has been derived using scientific principles and analogous data from similar projects where physical survey and sampling has been carried out. This analogous data is used to benchmark and validate any assumptions made.
Q. What confidence do we have in the information about the current cell contents, and how do we know this? Q. There is a concern that too much relies on modelling.	A. A detailed level of confidence assessment was performed to identify areas of weakness, and their significance to the evaluation of the long-term management options. This assessment is provided in Chapter 3 of the Cell Contents Technical Report.
Q. Robust, long-term monitoring will be needed to make this option comfortable, in order to validate the assumptions made in the analysis.	A. Fairfield are currently reviewing monitoring options and will be discussing these with the Regulator in due course.

3.3.3 Structural integrity

Stakeholder Question / Issue	Fairfield Response
Q. What will be the effects of the higher than predicted hydrogen sulphide (H_2S) levels on the concrete degradation?	*See section 3.4.4 below on hydrogen sulphide and degradation.*

Q. The recommended option assumes that there is a very low risk of leaks. Q. How will the integrity of the cells evolve over time?	A. Leaks will be inevitable; however their volume will be limited due to the design of the structure (highly compartmentalised due to formwork) and the fact the oil is fairly evenly distributed across all the cells. A. It is anticipated that leaks of oil into the leg cavities will start to happen in the near term 20-30 year period. This oil will remain contained until the legs start to collapse; this is expected in around 250 years. The cell tops and externally facing concrete walls will start to spall and open up communication paths to the external environment, exposing the contents and releasing small volumes of the buoyant mobile oil. This spalling and gradual degradation of the structure will happen over thousands of years.
Q. What happens when the legs collapse on top of the cells in 250 years and 1500m^3 of oil is released?	A. The legs will not collapse in their entirety but will instead gradually degrade due to spalling of the concrete. This will happen over a very long time scale, centuries to millennia. There is no collapse scenario that would result in the full residual mobile inventory being released instantaneously, instead this will be a gradual release as new communication paths open up in the structure. The size of these releases will be so small that the oil will very rapidly disperse and no intervention would be required.

3.3.4 Comparative assessment criteria, weighting and sensitivity analysis

Stakeholder Question / Issue	Fairfield Response
Q. Do the environmental criteria used actually cover all the environmental risks?	A. The CA evaluation criteria was carefully considered and those selected have been used to differentiate between the options. Included in the assessment were Operational Marine Impacts (including disturbance of the drill cuttings pile and marine noise), Energy & Emissions and Legacy Impact.
Q. What is the rationale behind the weighting of the criteria for the cell contents analysis? There might be considerable differences in costs depending on the different scenarios; therefore a 20% economic weighting might not be suitable. For example, if the costs are £500m or £5m, the weighting would be different; or if leaving in situ, environmental and legacy become really important, so perhaps should have greater weighting.	A. Similar to the CA for the CGBS an equal weighting was adopted. This is standard industry practice and requires significant justification if it is to be deviated from. It was felt that in weighting one criteria more than another that this may suggest that one stakeholders view is held more highly that another. Note that the MCDA approach compares options against each other as weaker or stronger, and does not use global scales as are suggested in the question; this therefore eliminates the effect of inappropriate scaling skewing the option scoring. During earlier internal CA workshop sessions with our joint venture partners, we discussed and reviewed the sensitivity of the environmental legacy impact criterion, and agree with the comment that it is fundamentally the main area of interest within the CA

	process, but the decision was made as discussed above to retain the equal weighting system.
Q. There should be sensitivities for all weightings, not just economic.	A. During the workshops and subsequent to them, the sensitivity analysis requirements were reviewed. Whilst in other CAs, very thorough weighting checks have been carried out to determine extremes such as swing weightings, it was felt that this would not provide any more robust support or value to the CA recommendation, and that in documenting this it would add to the complexity of the assessment, and may even reduce stakeholders understanding of the influencing factors in the assessment by providing too much mathematical information.

3.3.5 Presentation of results

Stakeholder Question / Issue	Fairfield Response
Q. The comparative assessment is complex and difficult to understand. The comparative assessment needs to be clearer for the public. The CA should be a tool to support the explanation for the decision rather than a problem-solving tool. Q. The technical work will be hard for a lay person to understand. Q. The way it is articulated is key. It needs to be communicated so that people can understand it. Q. There is a lot of information here and part of it is actually about providing the evidence and clarity to the public. There are also links to the modelling versus measurement issue and being clear about why it is not always possible to sample or measure. The issue is how to present this well. Q. Whether the rationale of it will be articulated sufficiently well to the public.	A. *See section 3.4.5 below on the articulation of results.*
Q. I feel that Fairfield have come up with a good answer / decision, but that the evidence / arguments feel weak. It may be just that we have not had time to hear sufficient information. Q. We have had a lot of information in a short time and the evidence may all be there, but we have only heard a piece of it. Hard to cover so much detail and therefore hard to present all the information well.	A. The cell contents management options for the residual contents have been extensively reviewed to determine whether there is any merit in further recovery, noting that the majority of the oil was recovered in 2007 by Shell. Through scoping and understanding the important factors, what we have found is that the residual inventory is now so low that there is very little environmental benefit in recovering them. Coupled with this, there are significant technical challenges with both accessing the cells and then recovering the highly distributed contents. In fact, the studies have shown that full recovery of the contents is not technically feasible unless the full structure is

Q. The evidence is weak. Q. It feels less robust and that there are more outstanding questions compared with the CGBS option.	removed, and even then, this would result in release of contaminants to the environment in doing so. An added difficulty is the environmental impact associated with disturbance of the drill cuttings pile, which is undesirable.
Q. What is the missing 1.38% shown in the "Cell Contents Inventory Summary" calculation on page 1 of the *Dunlin Alpha Cell Contents Fast Facts* workshop handout [see appendix 5]?	A. During the workshop discussion, Fairfield explained that differences in the numbers may be due to rounding the percentage figures down to one significant figure for the very small volumes. The numbers also conservatively assume that a proportion of the hydrocarbons in the sediment and wall residue will have diffused into the mobile oil phase, thus increasing the volume of the inventory that could be released. There is further detail shown on the inventory contained in the information posters on cell contents displayed at the workshop which explains this (see copies at appendix 7). **Post Meeting Note:** This has been subsequently reviewed and the numbers are correct. We believe that the comment refers to the proportion of the volume which is occupied by the water phase 98.62%, and that the remaining 1.38% is the other oil, sediment and wall residue phases. We believe the stakeholder misinterpreted the table as cumulative percentages rather than proportions of the total 100%.

3.3.6 Public and stakeholder reaction

Stakeholder Question / Issue	Fairfield Response
Q. We are looking at this from an insular, industry perspective, our understanding is good and we can appreciate the issues involved. Public opinion or that of other stakeholders may be different and lead to challenge. Will the work done to inform the recommendation (modelling not sampling) be 'good enough' for the public? Is there enough justification for leaving the cell contents behind? Q. Whether the rationale of it is justifiable to the public.	A. *See section 3.3.5 above.*
Q. The public now are more socially aware, media savvy and environmentally focused and have higher expectations than previous generations.	A. This is why we wish to be open and honest about the situation and demonstrate that Fairfield is a responsible decommissioning operator which is endeavouring to make the best possible recommendation when it comes to these things.
Q. I am concerned that others might say "you'd say that anyway" because of not spending money. There is a need to be squeaky clean.	A. This perception would not be justified as we have assessed the recommendation against the sensitivity to the economic criterion and shown that even when removing cost from the evaluation, the preferred option is to leave the contents in situ.

Q. Another factor is that the cost of the option selected will be also be paid for with money from the public purse, so it is a complex picture.	A. Agreed; to recover the residual contents for Option 1 (the high oil and sediment recovery option) would cost in excess of £60m, with recovery of only approximately 600m^3 of oil and 270m^3 of sediment.
Q. One stakeholder challenge I have heard previously: if the cell contents were assets to be recovered, would the approach be the same?	A. Yes, the approach would be the same. The CA is a robust decision-making process that can incorporate the resale/reuse value (both monetary and environmental) of recovering materials. The value of the materials to be recovered is low, with the mobile oil resale value at less than £200k.

3.3.7 Liability in perpetuity

Stakeholder Question / Issue	Fairfield Response
Q. If the situation is reviewed through OSPAR due to technological advance, and the structure has to be revisited and dealt with later, whether the cost of that been factored into the comparative assessment.	A. *See section 3.4.6 below on liability in perpetuity.* Note: the CA does not account for any future remediation costs.

3.3.8 Technological innovation

Stakeholder Question / Issue	Fairfield Response
Q. There may be criticism that technology has not been moved on; whether the industry is working hard enough to solve the issue of residual oil/ contaminants.	A. Fairfield have invested in technology development to survey and sample the cell contents, and have been working with the supply chain to come up with new approaches to accessing the cells to retrieve data. In addition, technological solutions for the liability monitoring are being scoped, and research and development partners identified.
Q. Technological limitations are being used as an excuse. Demolition technologies are very advanced in other industries. More could be done.	A. Fairfield have taken an optimistic approach to the technology capability during the evaluation of the options, as this should not be a barrier to selecting the optimum solution. The technology required to execute this project is not readily available, i.e. scale-up of the Enpro hub to drill through and access the cells is required, as well as appropriate tooling to move from the hub cell to the neighbouring compartments to allow extraction of the oil, and tooling to suction the sediment from the cell floors. It has been assumed that these challenges could be overcome with research, development and financial investment. The challenges presented in working in this environment should not be underestimated or compared with what is achievable in an onshore environment.

Q. If we want to take advantage of natural resources there is the potential for negative legacy, so we need to be cleverer and build in decommissioning ability.	A. Absolutely, and Fairfield recognise the importance of documenting lessons learned from decommissioning and translating and communicating these for the design of future installations. Fairfield have been actively supporting a Joint Industry Project to promote Design for Decommissioning (otherwise known as D4D).
Q. Future technological innovation should be taken account of, as should learning from other decommissioning projects.	A. This has been a consideration, especially with respect to learning from other projects. We know that on the Maureen project there were difficulties with removing the walls' residues, on Ekofisk the target removal for the sediment materials was not achieved and subsequent difficulties were encountered with processing the sediment waste stream. We also know that the oil phase is likely to much more viscous now, and that this presents challenges in extracting the fluids as seen by Shell on the Brent platforms. Whilst technology is a great enabler, it would be disingenuous of us to make promises or commitments to innovate further or reassess the leave in situ decision, when the Comparative Assessment has already shown that further intervention to the cells would use significant resources with very little reduction in the environmental legacy impact, due the small residual inventory remaining.
Q. The recommended option assumes that future generations will be better placed to deal with environmental impacts than we are.	A. This is not what the Comparative Assessment concludes, but rather that the environmental impact is so minimal it would be disproportionate to expend significant resources to recover it. Our assessment shows there should be no requirement for further remediation in the future, and that the best option is to leave the contents to degrade and be released or exposed naturally over time.

3.3.9 Safety evaluation

Stakeholder Question / Issue	Fairfield Response
Q. If we are looking at recovery, how would they do it? If there are people down there it is a safety concern; if not, it's not.	A. Recovery would be achieved by pumping through new access points in the tops of the cells. The access hubs can be installed by remotely operated vehicle (ROV); this reduces the personnel safety risks, however there are still risks associated with the marine vessel activities in general.

3.3.10 Oil removal

Stakeholder Question / Issue	Fairfield Response
Q. Why was no option carried forward that was attic oil only?	A. This was included as Option 3, which focussed on maximising the mobile oil recovery, while at the same time minimising disturbance of the drill cuttings. We did consider including an option which was effectively an oil-only option of Option 1, but this was screened out to ensure that the formal CA evaluation was focussed on options with clear differentiating characteristics, and that not too many options were considered.
Q. My preference would be to investigate full oil removal. I feel there could be more research into this. I am still concerned about oil release.	A. The oil has already been recovered in 2007 by Shell when they undertook the Attic Oil Recovery Project (AORP). The oil which remains is a very small proportion of the original inventory (<3%), there is also a very clearly demonstrated "law of diminishing returns" in the results of the Shell project, where the oil recovery reached a plateau, and no more oil could reasonably be recovered.

3.3.11 Options screening and selection

Stakeholder Question / Issue	Fairfield Response
Q. How did you screen down from 70 to 4 decommissioning options?	A. The options were defined in a systematic and logical way to identify permutations of cell access and contents recovery variations. From this basis, screening metrics were created to evaluate effectively the level of effort versus reward, or in other words, the resources required versus the percentage of inventory retrieved. The most attractive options were identified and further reviewed to optimise their efficiency and make them as attractive as possible to compete with the leave in situ option.
Q. Has the approach of drilling a hole at the bottom of the cell, and a hole at the top to allow for gradual seepage of contents been considered?	A. Yes, this has been reviewed as an additional mitigation for the leave in situ option, as it may enhance the natural attenuation of the hydrocarbons. This is further discussed in Chapter 5 of the Cell Contents Technical Report. However, given that the residual inventory is both small and highly compartmentalised and has a minimal environmental impact already, this option was discounted.
Q. Could more be done to investigate the bioremediation route? It feels like there is more potential. For example, could heat be added somehow to help the bugs survive and thrive?	A. We have reviewed this option in detail and do not believe it would be an effective solution. The suggestion that the biological processes could be supported by the addition of heat is not technically feasible, the amount of energy required is significant, just to increase the temperature of the sediment volume by 10°C would take billions of Joules of energy. This is before even considering how to engineer a way of applying and maintaining this heat.

3.3.12 Derogation application

Stakeholder Question / Issue	Fairfield Response
Q. There is uncertainty about the OSPAR reaction to the derogation. For example, there are members with a strong pro-environment stance. Q. Cell contents have not yet been considered by OSPAR, so it is not clear what is needed.	A. Fairfield will present their case through a Derogation document to BEIS. It is then between the OSPAR contracting parties to assess the proposals to decide whether derogation is an acceptable solution.

3.4 Key questions or issues to be addressed

The following points were selected by the table groups as significant to feed back to the plenary session.

3.4.1 Cumulative impact

Stakeholder Question / Issue	Why it is important	Fairfield Response / Where it is addressed
Q. Has environmental cumulative impact been looked at, given that a number of facilities are expected to decommission over the coming years?	Assurance is needed that the full picture of environmental impact has been established when evaluating this option.	A. The Environmental Appraisal (EA) document looks at cumulative effects. We do not expect there to be cumulative effects between Dunlin Alpha and other neighbouring installations. In particular the EA for drill cuttings and cell contents looked at Dunlin Alpha and the wider surrounding area. If you compare the effects of the decommissioned structure over time compared to its operational period, the effects are very small. Any impacts are taking place over a very long period of time and the amounts involved are relatively small.

3.4.2 Environmental evaluation

Stakeholder Question / Issue	Why it is important	Fairfield Response / Where it is addressed
Q. What is the comparative impact of later releases if the structure is left in place, compared to any accidental impact now for removal?	To demonstrate that the options have been thoroughly assessed and that the recommended option is the optimum.	A. Release scenarios and their associated inventory have been looked at. For removal scenarios and their impacts, we established that the inventory for the failure of an umbilical hose connection to an access point, and for the loss of containment of one cell, would be 10-15m^3. For

		leave-in-place scenarios and their impacts, we established that the inventory for an instantaneous release, assumed to be caused by the fall of a whole transition and resulting in the release of four cells, would be $60m^3$. For gradual release, if the contents were left in place, the inventory would be less than $0.5m^3$. The impact in these scenarios is likely to be limited by other factors. The formwork lattice structure in each of the 75 oil containing cell tops further compartmentalises the remaining trapped oil, and so would limit the release in any cell collapse scenario. In addition, the drill cuttings on top of the cells would provide a barrier to prevent release. A transition is unlikely to fall as a whole, since degradation and gradual disintegration of the metal is expected as a more likely outcome.

3.4.3 Sampling and validation

Stakeholder Question / Issue	Why it is important	Fairfield Response / Where it is addressed
Q. Where has the evidence for this option come from? Is it all desk-based? Has there been a physical survey or sampling of cell contents, and of the contents of the legs, and will this be done?	It will give people more confidence in the findings.	A. There was a need to increase confidence in the information and work already carried out on cell contents, since this was mostly desk-based. Validation was needed to test the assumptions arrived at about the contents of the cells. Dynamic modelling of the mobile oil has been done to test the efficiency of the attic oil recovery project and as additional evidence. Validation has also been achieved through the review of the work of other projects on cell contents and their physical evidence, and comparing it with Dunlin Alpha. There has also been a review of historical data from Dunlin Alpha itself, from the topsides cleaning preparations and water sampling undertaken during operational activities. While Fairfield has not achieved physical sampling of the inside of the cells to inform the comparative assessment, it does have the supporting data. We had anticipated being able to sample but that now looks challenging. We would expect that sampling, if it could be done, would validate,

		but not change, the findings of the CA. It would be a bonus to get a sample. We do have increased confidence from the validation work already undertaken and feel we know enough.

3.4.4 Hydrogen sulphide and degradation

Stakeholder Question / Issue	Why it is important	Fairfield Response / Where it is addressed
Q. Will the levels of hydrogen sulphide (H_2S) impact on the degradation rate of the concrete?	A level of comfort with the recommended option is gained from the long-term structural integrity of the cells and the associated containment of their contents. If there is a matter that could compromise this situation, it is important to know about it.	A. Atkins, the technical consultancy which has conducted many of the supporting studies for the comparative assessment, is assisting into investigating the current operational issues within the CGBS legs and cells and will also need to consider the impact, if any, that this new information may have. It is still under investigation and Fairfield will update stakeholders if there are any concerns.

3.4.5 Articulation of results

Stakeholder Question / Issue	Why it is important	Fairfield Response / Where it is addressed
Q. There is concern about how the work that has informed the recommended option will be understood by a cross-section of the public. Articulation of the results is challenging due to the complexity involved. This includes the robustness of the sampling or modelling approach and the knowledge of the cell contents. For example, there could be a challenge that Fairfield should sample all the cells because there is no guarantee of connectivity and therefore similarity between the contents of each cell; or a challenge about how the composition of the contents might change over time, what impact that might have, and how that would be known?	There is potential for the recommended option to be challenged in the public domain, not because the work undertaken by Fairfield and the company's rationale is insufficiently robust, but because these cannot be readily understood.	A. The decommissioning is too complex a piece of work for any simpler evaluation to have been done. We appreciate it is difficult for members of the public to understand it easily. The report provided as pre-read for stakeholders has been prepared in order to make the information about the comparative assessment process accessible. There are also more detailed reports, which have more in-depth technical detail, for those that want that further level of information. The comparative assessment reflects a lot of work done over a long period. It is challenging with so much information, how to present that in the public domain, which we need to do. We are trying to find accessible language to support that, for example the scale comparisons between the platform and more familiar structures in the public domain. It is difficult to pitch communications to everyone and

		accommodate both those who need accessible and detailed information. We will keep trying to meet that challenge.

3.4.6 Liability in perpetuity

Stakeholder Question / Issue	Why it is important	Fairfield Response / Where it is addressed
Q. The issue of liability in perpetuity and the full consequences of it is not well understood (not just by Fairfield, but as an industry). The law is clear, but what that means in this case is yet to be determined, given the limits on the lifespan of private companies. What assumptions or guarantees are being made about OSPAR requirements? Is the potential accounted for that companies may be required to return to the structure and undertake further removal? What economic assumptions have been made? Are economic contingencies being put in place in case a return to the structure for further removal is required?	Liability is seen as a key contingency and aspect of uncertainty of the recommended option by some stakeholders, and one which may make the option less preferred or comfortable.	A. In the case of the cell contents, we have assessed that there are no scenarios that would require intervention, therefore Fairfield have not allocated any contingencies in terms of financial capital for future remediation related to release of cell contents. *Please see also the previous response for the CGBS, section 2.5.1*

4. Outstanding Concerns

The stakeholder evaluation questionnaire, which was circulated at the conclusion of the workshop, included a question that asked participants whether they had any outstanding concerns that they would like Fairfield to address. This was a further way in which the process sought to check stakeholders' comfort level with the emerging recommendations, and capture any remaining issues which may not have been raised or fully expanded during the workshop.

There were five responses from stakeholders, and also a further point raised under the final question in the evaluation form of 'any other comments'. These issues are set out below and Fairfield Energy has provided a response about how they are being, or will be, addressed.

Stakeholder Issue	Fairfield Response
It is in Fairfield and the industry's interest to articulate their decisions and how they made them in a very accessible way. Relying on a technical process to support the decisions made will not suffice in terms of communication. Ensure key public challenges are anticipated and response prepared.	By its very nature, the study work is largely technical and based on engineering principles. The evaluation of the various options within the comparative assessment process has been predominately quantitative but we believe this makes the decision making as transparent as possible. The Consultation Draft Decommissioning Programme will attempt to communicate the proposals in a manner which makes them accessible for the broad stakeholder base.
The structure cells / legs and cuttings piles are all linked. In 250 years the legs may collapse catastrophically, then cells and cuttings piles will be disturbed. Generally, more research is required on oil degradation in both the cells and cuttings piles. Long term, i.e. at leg failure, what is the cumulative impact?	The evaluation of the scenarios shows that there is unlikely to be a catastrophic failure of the structure that would result in large scale disturbance of the drill cuttings pile and residual cell contents. Fairfield agree that an understanding of the physical fate of the cell contents is important and we are looking further at this with academia, specifically the mass transfer (diffusion) of hydrocarbons and the natural attenuation effect due to microbial activity. Cumulative impacts (for the cell contents and drill cuttings pile) are discussed in more detail in Chapter 5 of the Cell Contents Technical Report and the Environmental Appraisal, and are assessed to be not significant.
Not a concern, however, I would look forward to a better understanding the technology deployed so far in relation to gaining samples.	Chapter 3 of the Cells Contents Technical Report includes a discussion on the inventory validation activities employed to date.
Consider 'future proofing' Option 9 by completing leg internal work for an IMO leg cut at later date when technology develops.	As described in Section 2 above, each of the presented options should be considered as a complete scope rather than an interim solution. Fairfield see little value in performing hazardous internal leg work for a derogation option which is not being proposed for implementation.
After the topside section is removed, I would suggest the legs to be monitored. Structural health monitoring will be a good option.	As described in section 2 above, Fairfield anticipates a risk-based monitoring programme to be agreed with the regulator as part of the regulatory approvals process.

Dunlin Alpha Decommissioning Workshop 3 May 2018
Final Delegate List and Invitees

ORGANISATION	DELEGATE
Aberdeenshire Council	Alistair Reid
Department for Business, Energy & Industrial Strategy	Audrey Banner
	Ben Bryant
	Debbie Taylor
	Lisa Yates
CNR	Roy Aspden
Cromarty Firth Port Authority	Zeina Sawaya-Melville
Decom North Sea	Tom Leeson
Dunlin Alpha Offshore Installation Manager	Alan Reid
Edinburgh University	Lea-Anne Henry
East of England Energy Group	David Gerrie - Stork
	Martin Myhill Sisley – James Fisher
EnQuest	Dave Madill
Forth Ports	Ann Rooney
Health & Safety Executive	June Calder
	Stewart Millar
Independent Review Group	George Fleming
	Ruby Lowe
	Andrew McNulty
	Martin Muncer
	Jennifer Richards
Marine Scotland	Peter Hayes
Oil & Gas Innovation Centre	Ernie Lamza
Oil & Gas Technology Centre	Roger Esson
Oil & Gas Authority	Alan Ransom
Oil & Gas Institute	Bryan Atchison
Oil & Gas UK	Richard Heard
Scottish Enterprise	Karen Craig
Scottish Environment Protection Agency	Brian Blagden
	Michael Buchan
	Kat Raines
Shetland Oil Terminal Advisory Group (SOTEAG)	Heather Runnacles Goodridge
Statoil	Simone Silcock
TAQA Bratani	Alan Campbell
	Mike Bayley
University of Aberdeen (Centre for Research in Energy Economics & Finance)	Alex Kemp
University of Aberdeen (Decommissioning MSc)	Peter Macfarquhar Cacela
	Iain Mackenzie
University of Aberdeen (School of Biological Sciences)	Astley Hastings
University of Strathclyde	Selda Oterkus

FACILITATION TEAM	Emma Cranidge, Alison Davies, Irene Evison, Steve Evison, Mike King, Erica Sutton, Cerys Thomas
FAIRFIELD CONSULTANTS	
Atkins	Eilidh MacLeod, Philip Walker
Xodus	Iain Dixon, John Foreman
FAIRFIELD ENERGY	
Project Team	Rebecca Allan, Carol Barbone, Jonathan Bird, Jeff Burns, Caroline Laurenson, Peter Lee, Graham Lonie, Gary Owen, John Wiseman

INVITED BUT NOT IN ATTENDANCE

Aberdeen City Council
Aberdeen & Grampian Chamber of Commerce
Aberdeen Harbour Board
Aberdeenshire Council
Asociacion de Armadores
British Geological Survey
British Marine Federation
British Ports Association
Capturing the Energy
CEFAS
Cetacean Research and Rescue Unit
Comité National des Peches
Danish Centre for Marine Research
Danmarks Fiskeriforening PO (Danish Fish Producers)
Energy Industries Council
Environment Agency
ExxonMobil
Faroese Fishermen's Association
Friends of the Earth (Scotland)
Global Marine Systems
GMB Scotland
Greenpeace Research Laboratories
Heriot-Watt University
Highlands & Highlands Enterprise
Historic Scotland
International Association of Oil and Gas Producers
International Marine Contractors Association
International Maritime Organisation
Joint Nature Conservation Committee
KIMO UK
Lerwick Port Authority
Marine Conservation Society UK
Maritime and Coastguard Agency
Marine Alliance for Science & Technology for Scotland
National Oceanography Centre
Newcastle University - SEAFRONT Project
National Federation of Fishermen's Organisations
NOF Energy
Norges Fiskarlag (Norwegian Fishermen's Association)
Northern Ireland Fishermen's Federation
Northern Lighthouse Board
North Sea Commission
North Sea Regional Advisory Council
Norwegian Environment Agency
Norwegian Petroleum Directorate
Ocean Governance
Offshore Contractors Association
OPITO
Opportunity North East
Peterhead Port Authority
Rederscentrale (Belgian Fish Producers Association)
RMT
RSPB Scotland
Royal Yachting Association Scotland
Scottish Fishermen's Federation
Scottish Association for Marine Science
Scottish Environment LINK
Scottish Wildlife Trust
Seas At Risk
Sea Source Offshore
Shell
Siccar Point Energy
Society for Underwater Technology
Society of Maritime Industries
Statoil
UK Fisheries Offshore Oil and Gas Legacy Trust Fund
Unite the Union
University of West of Scotland
VisNed (Netherlands Fish Producers' Association)
WDC Whale and Dolphin Conservation
WWF

Dunlin Alpha Decommissioning Workshop – Final Agenda

3rd May 2018
Aberdeen Exhibition and Conference Centre

Purpose of workshop:

- To update stakeholders on progress of the development of the decommissioning proposals for the Dunlin Alpha installation and on the emerging recommendations from the comparative assessment of options.

- To collectively reflect on the work to date and identify whether there are still any areas of outstanding concern which remain to be addressed before these are finalised within a formal programme for statutory and public consultation.

Agenda

10:00	*Registration, Coffee and Refreshments*
10:25	**Safety Briefing**
	Welcome – John Wiseman, Managing Director, Fairfield Energy
	Format for the Day – Mike King, Lead Facilitator, Resources for Change
10:45	**Activity since the Last Workshop** – Carol Barbone, Fairfield Energy
10:55	**Introducing the Independent Review Group** – Jennifer Richards, Hydrock
11:05	**Comparative Assessment Mechanics**– John Foreman, Xodus Group
11:15	**Emerging Recommendations for CGBS** – Peter Lee, Fairfield Energy
11:35	**Discussion Groups** – consideration of the emerging recommendations for the CGBS
12:30	*Lunch*
13:15	**Emerging Recommendations for Cell Contents –** Caroline Laurenson, Fairfield Energy
13:35	**Discussion Groups** – consideration of the emerging recommendations for cell contents
14:20	**Other Decommissioning Elements beyond the Comparative Assessment -** Peter Lee
14:35	**Question and Discussion**
14:50	**Evaluation** – Mike King, Lead Facilitator, Resources for Change
14:55	**Next Steps**, **Reflections and Close** – John Wiseman, Managing Director, Fairfield Energy
15:00	*Ends, Refreshments*

Appendix 3: Presentation Slides

The presentation slides for the decommissioning topics shown in this section were provided by Fairfield Energy's Dunlin Alpha decommissioning team. Other slides included in this appendix were provided by the Independent Review Group (IRG) in order to explain their role and involvement, and by Resources for Change (the facilitators for the event) which were used to support the workshop process.

Updates / Background

- **Update on Stakeholder Engagement:** Feedback from the previous stakeholder workshop, and involvement in the comparative assessment.
- **Independent Review Group (IRG):** How the group works, its composition, and its role.
- **Comparative Assessment (CA):** Overview, mechanics and purpose of the comparative assessment.

Topics for Discussion

- **Emerging recommendation for the Concrete Gravity Base Structure (CGBS)**: The output from the comparative assessment on the CGBS. Notes to accompany these presentation slides are included in this appendix.
- **Emerging Recommendation for the Cell Contents**: The output from the comparative assessment on the cell contents. Notes to accompany these presentation slides are included in this appendix.
- **Other Dunlin Alpha Decommissioning Elements -** those aspects outside the comparative assessment:
    - Topsides removal
    - Drill cuttings
    - Subsea infrastructure programme,
    - Export pipeline (PL5)

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Fairfield Energy
Dunlin Alpha Decommissioning

Stakeholder Workshop

3 May 2018

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Welcome

John Wiseman

Facilitated by Mike King

- Resources for Change (R4C)
  - Creating constructive interactions between people and places
- Facilitators role is to:
  - Help you have the conversations you need to have
  - Manage the process – to time and topic
  - Independent – no stake in the outcome
- Supported by 6 other R4C facilitators

www.r4c.org.uk

Stakeholder Dialogue:

"It's not about winning an argument but creating a better outcome"

www.r4c.org.uk

Purpose of today's workshop

- To **update** stakeholders on progress of the development of the decommissioning proposals for the Dunlin Alpha installation and on the emerging recommendations from the comparative assessment of options.
- To **collectively reflect** on the work to date and identify whether there are still any areas of outstanding concern which remain to be addressed before these are finalised within a formal programme for statutory and public consultation.

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Process

- Input from Fairfield – context setting & first Comparative Assessment recommendation
- Discussion
- Lunch
- Input from Fairfield – Second recommendation
- Discussion
- Other decommissioning elements & questions
- Next steps

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Working Agreements

- ✓ Chatham House rules
- ✓ Observers
- ✓ Please be respectful of all contributions
- ✓ One person speaks at the time
- ✓ Leave the day job till the breaks
- ✓ Please help us keep to time
- ✓ Recording and photos
- ✓ Excuse the facilitators for being bossy!

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Stakeholder Activity Since the Last Workshop

Carol Barbone

FairfieldEnergy

Principal Engagement Elements

Report on Workshop Proceedings issued for comment and review

- *Post-publication discussions/queries resolved*
- *Drill Cuttings and Cell Contents Reports shared*

Meetings, Briefings and Liaison

- *Regulatory, e.g. OPRED, OGA, SEPA*
- *Stakeholder, e.g. OGTC, universities, WWF*
- *Parliamentary presentations*
- *Industry workshops, conferences and supply chain meetings*

Comparative Assessment Evaluation Workshop

- *Pre-briefing, participation by key stakeholders*
- *Emerging Recommendations Report*

Going forward

- Today's workshop
- Workshop report for review and comment
- Follow up correspondence, meetings where required
- Any remaining gaps or showstoppers?
- Final inputs to Draft Decommissioning Programme before formal consultation

Dunlin Alpha CGBS Independent Review Group

3rd May 2018

Hydrock

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Who are we?

Name	Role/Expertise	Originating Company
Graham McNeillie	IRG Chairman	Hydrock
Jenny Richards	Regulatory issues and stakeholder engagement	Hydrock
Zoe Crutchfield	EIA and stakeholder/regulatory engagement	Arup
Andrew McNulty	Structural engineering	Independent (previously Arup)
George Fleming	Environmental science	Envirocentre
Stein Haugen	Risk	NTNU
Martin Muncer	HSE/safety assurance	Independent (previously HSE)
Eric Cooper	Project Manager	Hydrock
Ruby Lowe	Secretariat	Hydrock

Our Role

- We have a formal set of Terms of Reference, agreed with Fairfield
- Read and review, at a strategic level, relevant project documentation underpinning the Comparative Assessment process
- Provide comments to the project in respect of the scope, clarity, completeness, data, methodology, relevance and objectivity of conclusions
- Review Fairfield's work in preparing their Decommissioning Plan, considering
  - The thoroughness and quality of the technical work
  - The robustness of the arguments presented
  - Adherence to BEIS / OSPAR guidance and requirements when making a case for derogation

We are independent from the Project

When did we start and what have we done so far?

Formed in August 2017

Reviewed nearly 100 documents provided by Fairfield to date

Held 7 IRG meetings so far

Attended, as observers, relevant Fairfield stakeholder and Comparative Assessment workshops

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Output of the IRG's involvement

A report to accompany Fairfield's DP submission which will:

- Describe the work done by the IRG and that outside its scope
- Compare the submission to BEIS and OSPAR requirements
- Give an independent opinion on the proposed decommissioning option

IRG Report will be an annex to the Dunlin Alpha Decommissioning Plan

Thank you

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Comparative Assessment Mechanics

John Foreman

Introduction – Regulatory Context

Comparative Assessment used when Derogation is considered under OSPAR Decision 98/3 for:

- The footings of "Steel Structures weighting more than 10,000 tonnes in air which were installed before February 1999"
- **The structure is of a "Gravity-based Concrete Installation" design**
- "Any other disused offshore structure, which has suffered unforeseen structural damage or deterioration to an extent that its removal presents equivalent difficulties"

Requirements for Comparative Assessment are outlined in:

- OSPAR DECC Guidance Notes 'Decommissioning of Offshore Oil and Gas Installations and Pipeline under the Petroleum Act 1998" (Issued March 2011)
- Guidelines for Comparative Assessment in Decommissioning Programme (Issued by Oil & Gas UK in June 2015)

Comparative Assessment is used in the development of Decommissioning Programmes to:

- Compare options
- Examine differences
- Identify the optimal option

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Seven Steps of the Comparative Assessment Process

1. Scoping
2. Screening
3. Preparation
4. Evaluation
5. Recommendation
6. Review
7. DP Submission

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Comparative Assessment Status Summary

Stakeholder Engagement

1. Scoping	✓	Completed 2011
2. Screening	✓	Completed 2011 – Re-evaluated 2015
3. Preparation	✓	Completed 2012 – Increased focus in 2015
4. Evaluation	✓	Completed 2017 - 2018
5. Recommendation	✓	Ongoing Q2 2018 (including this workshop)
6. Review		Planned for Q2 2018 (post this workshop)
7. DP Submission		Planned for Q3 2018

Evaluation Methodology

- CA Guidelines

  Method A – Red / Amber Green Narrative – Qualitative

  Method B – Narrative & Scoring – Semi-quantitative

  Method C – Narrative & Scoring & Weighting - Fully Quantitative

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Evaluation Methodology

- CA Guidelines

  Method A – Red / Amber Green Narrative – Qualitative

  Method B – Narrative & Scoring – Semi-quantitative

  Method C – Narrative & Scoring & Weighting - Fully Quantitative

- Most Detailed Methodology Selected
- Multi-Criteria Decision Analysis (MCDA) Approach
- Appropriate to CCBS and Cell Contents Evaluation

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Evaluation Methodology

- ❑ Xodus Evaluation Methodology Selected
- ❑ Multi Criteria Decision Analysis (MCDA)
- ❑ Use principles of Analytical Hierarchy Process (AHP)
- ❑ Extensively used across many industries
- ❑ Employs Pairwise Comparison

Steps

- ❑ Describe and refine differentiating Criteria and Sub-criteria
- ❑ Define options and their attributes
- ❑ Discuss and record comparison of options
- ❑ Rank options against each criterion
- ❑ Summarise and report

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Criteria & Weighting

1. Safety [20%]
   - 1.1 Operations Personnel [6.66%]
   - 1.2 Other Users [6.66%]
   - 1.3 Legacy Risk [6.66%]
2. Environment [20%]
   - 2.1 Operational Marine Impacts [6.66%]
   - 2.2 Atmospheric Emissions / Consumptions [6.66%]
   - 2.3 Legacy Marine Impacts [6.66%]
3. Technical [20%]
   - 3.1 Project Technical Risk [20%]
4. Societal [20%]
   - 4.1 Fishing Industry [10%]
   - 4.2 Other Groups [10%]
5. Economics [20%]
   - 5.1 Operational & Legacy Costs [20%]

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Evaluation Methodology - Attributes

1. Safety	1.1 Operations Personnel	1. Option A	2. Option B	3. Option C
		Total option hours:- 409,488 Total option PLL:- 2.32E-02	Total option hours:- 252,816 Total option PLL:- 1.44E-02	Total option hours:- 206,64 Total option PLL:- 1.18E-0

2. Environmental	2.2 Atmospheric Emissions & Consumption	1. Option A	2. Option B	3. Option C
		- Emissions = 34,256 Te CO_2 equiv - Energy = 449,394 GJ - Fuel use = 10,451 Te	- Emissions = 20,382 Te CO_2 equiv - Energy = 267,386 GJ - Fuel use = 6,218 Te	- Emissions = 16,848 Te CC - Energy = 221,026 GJ - Fuel use = 5,140 Te

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Evaluation Methodology - Assessment

1. Safety	1.1 Operations Personnel	1. Option A			2. Option B		3. Option C
		Total option hours:- 409,488 Total option PLL:- 2.32E-02			Total option hours:- 252,816 Total option PLL:- 1.44E-02		Total option hours:- 206,64 Total option PLL:- 1.18E-0
		W	W	MW	N	MW	

2. Environmental	2.2 Atmospheric Emissions & Consumption	1. Option A			2. Option B		3. Option C
		- Emissions = 34,256 Te CO_2 equiv - Energy = 449,394 GJ - Fuel use = 10,451 Te			- Emissions = 20,382 Te CO_2 equiv - Energy = 267,386 GJ - Fuel use = 6,218 Te		- Emissions = 16,848 Te CC - Energy = 221,026 GJ - Fuel use = 5,140 Te
		W	W	MW	N	MW	

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Evaluation Methodology – Record of Discussion

1. Safety — 1.1 Operations Personnel

	1. Option A	2. Option B	3. Option C
	Total option hours:- 409,488 Total option PLL:- 2.32E-02	Total option hours:- 252,816 Total option PLL:- 1.44E-02	Total option hours:- 206,64 Total option PLL:- 1.18E-0

W	W	MW	N	MW	

Summary

The summary Potential for Loss of Life (PLL) metrics for the options are 2.32E-02, 1.44E-02, 1.18E-02 and Zero respectively. The assessment of the risk exp
Option 1 is assessed as being Weaker than Option 2 as it is around double the risk exposure. Option 1 is assessed as being Weaker than Option 3 as it is al
there is risk exposure for Option 1 versus none for Option 4.
Option 2 is assessed as being Neutral to Option 3 as the risk exposure is largely similar. Option 2 is assessed as being Much Weaker than Option 4 as there
Option 3 is assessed as being Much Weaker than Option 4 as there is risk exposure for Option 3 versus none for Option 4.
It should be noted that all options require similar activities just with longer or shorter durations. It should be further noted that none of the options have planned c

Overall, Option 4 would be the preferred option from a risk to operations personnel perspective.

2. Environmental — 2.2 Atmospheric Emissions & Consumption

	1. Option A	2. Option B	3. Option C
	- Emissions = 34,256 Te CO_2 equiv - Energy = 449,394 GJ - Fuel use = 10,451 Te	- Emissions = 20,382 Te CO_2 equiv - Energy = 267,386 GJ - Fuel use = 6,218 Te	- Emissions = 16,848 Te CC - Energy = 221,026 GJ - Fuel use = 5,140 Te

W	W	MW	N	MW	

Summary

The assessment of the impact of each of the options in terms of Emissions and Consumptions is as follows:
The assessments made consider the scale of the emissions and consumptions for each of the options in a wider context.
Option 1 is assessed as being Weaker than Option 2 due to the emissions / consumptions being are a little under double, but of a reasonable absolute quantity
being Weaker than Option 3 for similar reasons. Option 1 was assessed as being Much Weaker than Option 4 as the emissions / consumptions associated wit
Option 2 is assessed as Neutral to Option 3 as, whilst there is a differential between the emissions / consumptions, this differential is considered insignificant wh
/ consumptions associated with Option 2 are significant when compared to a zero emissions / consumptions option
Option 3 is assessed as being Much Weaker than Option 4 for similar reasons.

Overall Option 4 would be the preferred option from an Emissions and Consumptions perspective.

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Evaluation Methodology – Scoring System

Phrase	Percentage Preference	
Neutral	50	50
Stronger (S) / Weaker (W)	60	40
Much Stronger (MS) / Much Weaker (MW)	75	25
Very Much Stronger (VMS) / Very Much Weaker (VMW)	90	10

2.1 Operational Marine Impact	Option A	Option B	Weighting
Option A	N	S	60%
Option B	W	N	40%

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Evaluation Methodology – Scoring System

1.1 Operations Personnel	Option A	Option B	Option C	Option D	Weighting
Option A	N	W	W	MW	14%
Option B	S	N	N	MW	
Option C	S	N	N	MW	
Option D	MS	MS	MS	N	

4.1 All Groups	Option A	Option B	Option C	Option D	Weighting
Option A	N	W	W	N	20%
Option B	S	N	N	S	30%
Option C	S	N	N	S	30%
Option D	N	W	W	N	20%

3. Technical	Option A	Option B	Option C	Option D	Weighting
Option A	N	N	W	MW	16%
B	N	N	W	MW	16%
C	S	S	N	W	25%
D	MS	MS	S	N	44%

2.2 Atmospheric Emissions & Consumption	Option A	Option B	Option C	Option D	Weighting
Option A	N	W	W	MW	14%
Option B	S	N	N	MW	18%
Option C	S	N	N	MW	18%
Option D	MS	MS	MS	N	50%

)perational &)gacy Costs	Option A	Option B	Option C	Option D	Weighting
Option A	N	W	W	MW	14%
Option B	S	N	N	MW	18%
Option C	S	N	N	MW	18%
Option D	MS	MS	MS	N	50%

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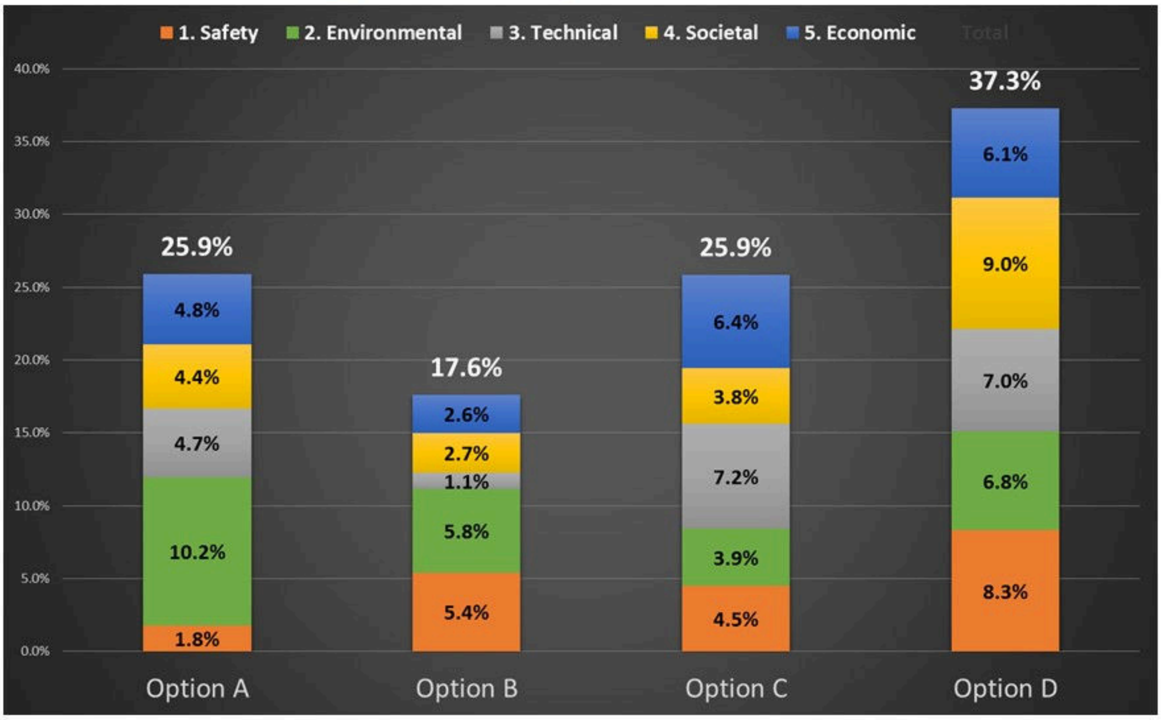
Evaluation Methodology – Visual Output



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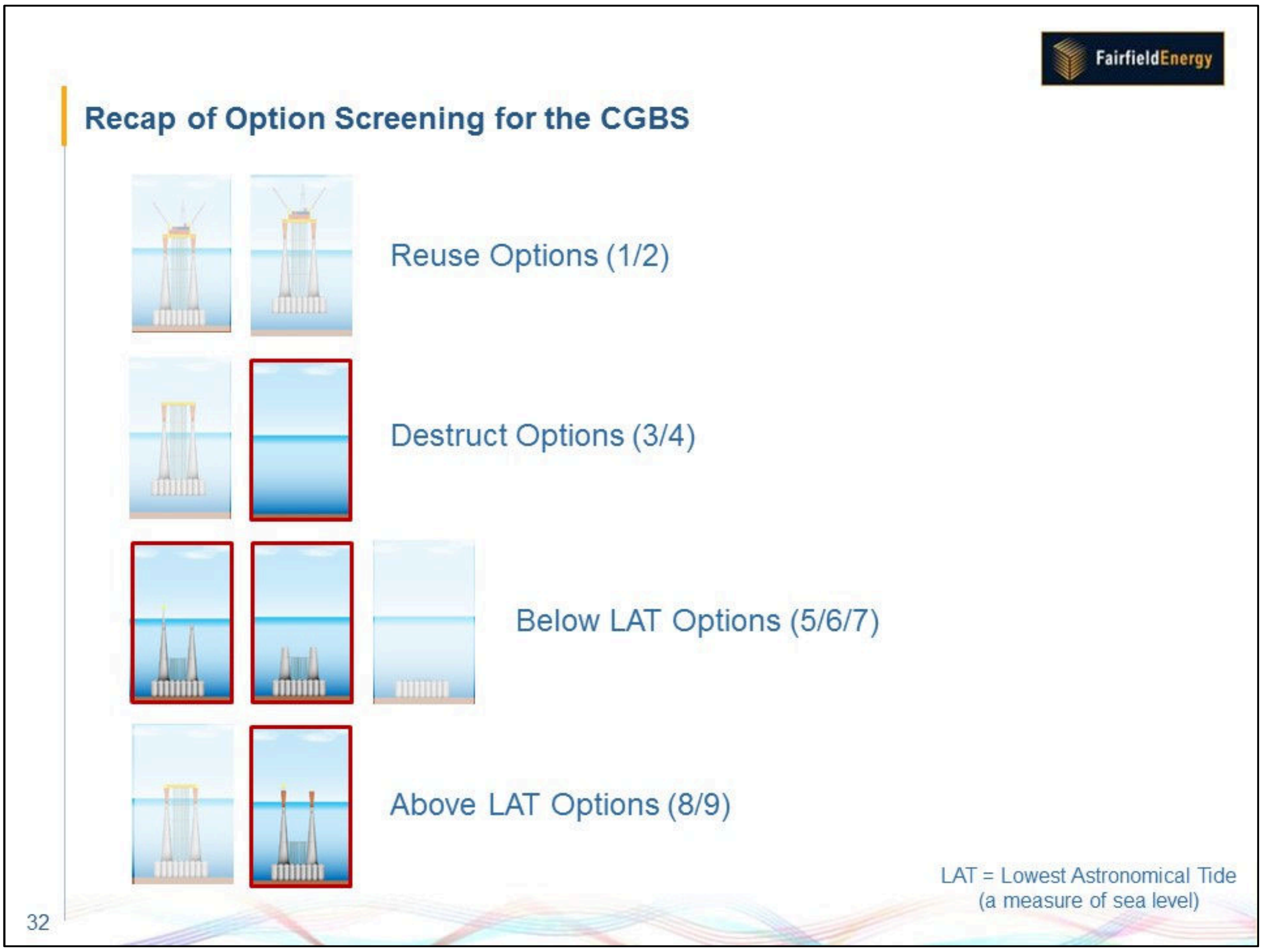
Emerging Recommendation for the Concrete Gravity Based Structure

Peter Lee



The Scoping Phase of the Comparative Assessment Process was undertaken in 2011. This generated seven principal options.
Studies were conducted to inform the Screening Phase - including a Reuse Report, Refloat Report and In Situ Deconstruction Report.
At that time, the 'Shallow Cut and NAVAID Tower' (option 5) appeared to be the preferred option and became the reference case.

In 2015, following Cessation of Production, Fairfield re-evaluated the Scoping and Screening exercises, adding two above-LAT options.

The Screening of the nine options concluded:

1. No credible re-use of the structure in its current location. Screened out.
2. No ability to refloat the structure to re-use in another location. Screened out.
3. No ability to refloat the structure to a near shore location for dismantlement. Screened out.
4. Possibility of deconstruction in situ – a 'piece small' removal of the CGBS. Screened in.
5. Credible shallow cut, followed by challenging installation of NAVAID tower. Screened in.
6. Credible deep cut to LAT-55m. More challenging cut than the shallow cut but avoids NAVAID tower. Screened in.
7. Possibility of full removal of legs, but more challenged than option 6 and little additional benefit. Screened out.
8. Retention of the transitions and Module Support Frame. Limited structural benefit. Screened out.
9. Retention of transitions and placement of NAVAID. Screened in.

Screening therefore generated four options – one full removal case and three partial removal cases requiring a derogation.

Options in Comparative Assessment

Method Statement for Full Removal (Option 4)

1. Plug and Abandon the Platform Wells
2. Make Safe the Topsides
3. Remove Hazardous Material from Legs
4. Secure Leg Internals prior to Leg Removal
5. Remove Topsides and Transitions to LAT-8m
6. Remove Upper Sections of Legs to LAT-55m
7. Remove Lower Sections of Legs to LAT-119m
8. Remove All Drill Cuttings
9. Flush Water from all Cells & Treat for Disposal
10. Cut a Hole in a Cell Wall for ROV Access
11. Remove any Mobile Oil from Internal Cell Roof
12. Remove any Solids from Internal Cell Floor
13. Cut and Remove Cell Walls
14. Repeat 10-13 for Remaining 80 cells
15. Remove 88,000 Tonnes of Iron Ore Ballast
16. Cut and Remove Cell Floors
17. Cut and Remove 4m CGBS Skirt & Grout
18. Remediate Seabed

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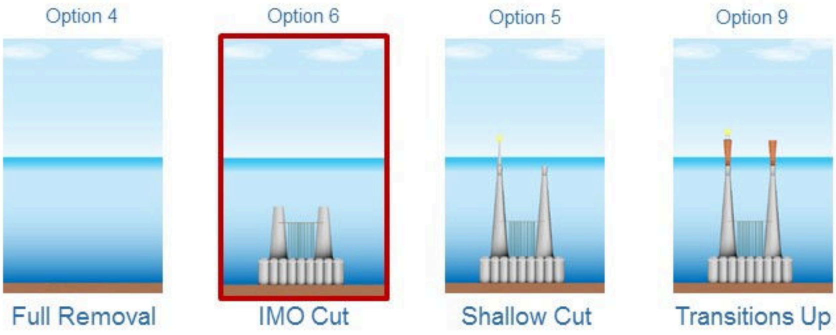
Each of the screened four options has **common decommissioning scope**, including:

- Plug and abandonment of the 45 platform wells
- De-energising, de-pressuring, de-oiling, flushing & cleaning of the facilities
- Preparation of the topsides facilities for their ultimate removal
- Surveying and removing of hazardous materials
- Securing or removing of leg internals as required
- Remove topsides facilities – traditionally in a series of heavy lifts
- Remove the Module Support Frame

Option 4 is the '**Full Removal**' option. This would be a non-derogation option.
It is based on a methodology of 'piece small' deconstruction using work class Remote Operated Vehicles (ROVs).
Following the above common scope, the steel transitions would be cut and removed.
The concrete legs would then be removed in a series of heavy lifts.
Drill cuttings pile removal by grab excavation.
Flushing of the cells within the CGBS base caisson.
Cut a hole in a perimeter side wall to allow access to a single cell.
Remove any mobile oil and sediment.
Cut and remove the side walls and recover to surface 'piece small'.
Repeat the above operation for the remaining 80 cells – out to in.
Cut and remove the cells floors and skirt.
Remove the grout and remediate the seabed.

This scope is extremely challenging from both a technical and safety perspective.
The overall project duration would be in the order of 30 years.

Options in Comparative Assessment



Method Statement for IMO Cut (Option 6)

1. Plug and Abandon the Platform Wells
2. Make Safe the Topsides
3. Remove Hazardous Material from Legs
4. Secure Transition Internals prior to Transition Removal
5. Secure Leg Internals prior to Leg Removal
6. Remove Topsides and Transitions to LAT-8m
7. Remove Upper Section of Concrete Legs to LAT-55m

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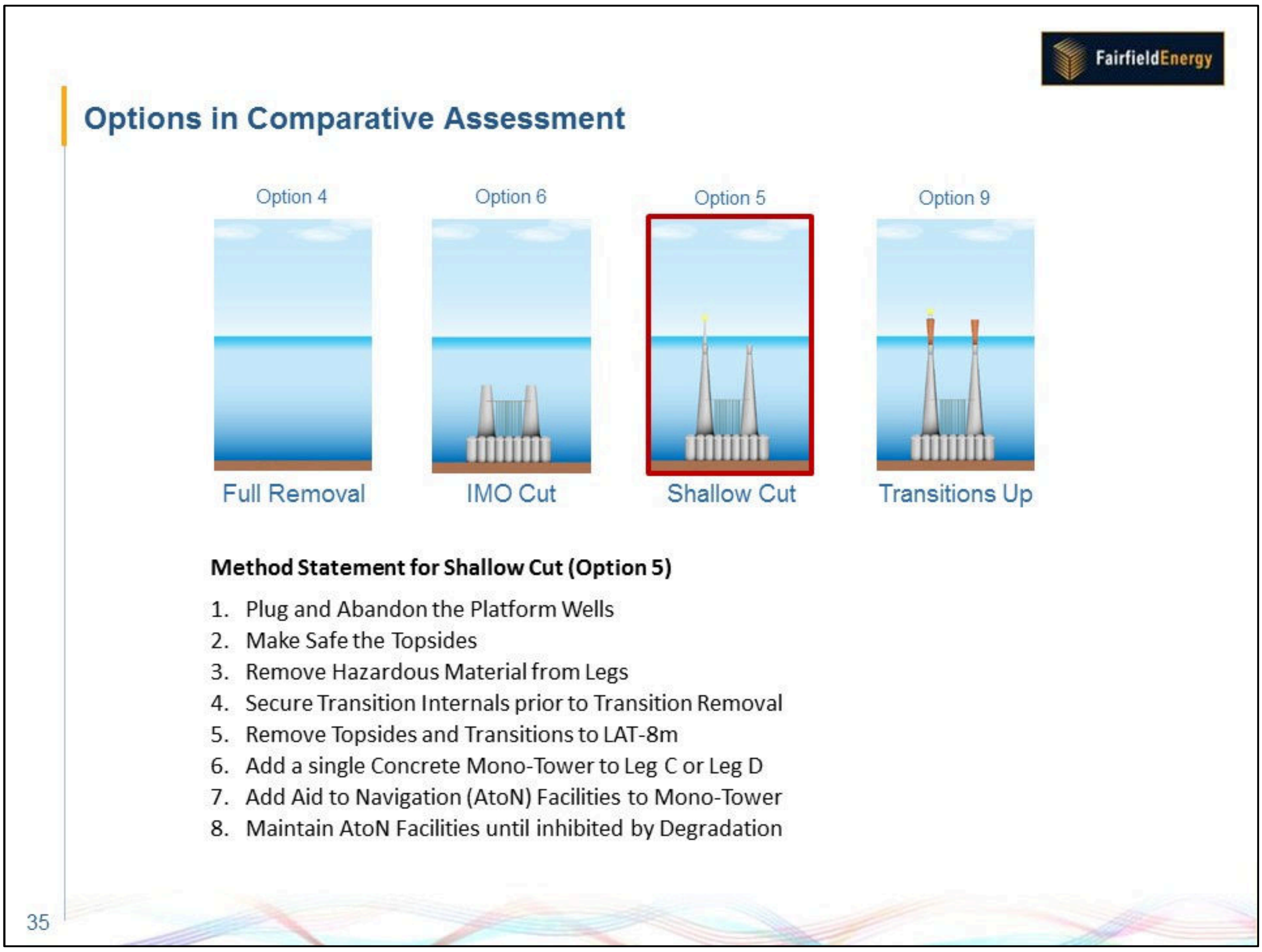
Option 6 is the '**IMO Cut**' option. This would be a derogation option.
It is based on a methodology of diamond wire cutting of the transitions & concrete legs

Following completion of the common scope, the steel transitions would be cut and removed.
The concrete legs would then be removed in a series of heavy lifts.
The deeper cuts would not be achieved in a single pass and would require orbital/chord cuts
The structure below LAT-55m would remain and be decommissioned in situ.
No NAVAIDs would be required due to the depth of the obstruction.



Option 5 is the '**Shallow Cut & NAVAID Tower**' option. This would be a derogation option.
It is based on a methodology of diamond wire cutting of the transitions and removal to shore.

Following completion of the common scope, the steel transitions would be cut and removed.
The cut elevation would be in the range of LAT-8m to LAT-20m (limited by geometry).
LAT-8m cut is operationally challenging whereas LAT-20m is structurally challenging.
The structure below the cut points would remain and be decommissioned in situ.
A concrete NAVAID mono-tower would be installed on one leg 'stump' and carry an Aid to Navigation.

Options in Comparative Assessment

Method Statement for Transitions Up (Option 9)

1. Plug and Abandon the Platform Wells
2. Make Safe the Topsides
3. Remove Hazardous Material from Legs
4. Apply internal Coatings to the Transitions
5. Add external Cathodic Protection to the Transitions
6. Cap the Top of the Transitions and Remove Topsides
7. Add Aid to Navigation (AtoN) Facilities to Leg C or Leg D
8. Maintain AtoN Facilities until inhibited by Degradation

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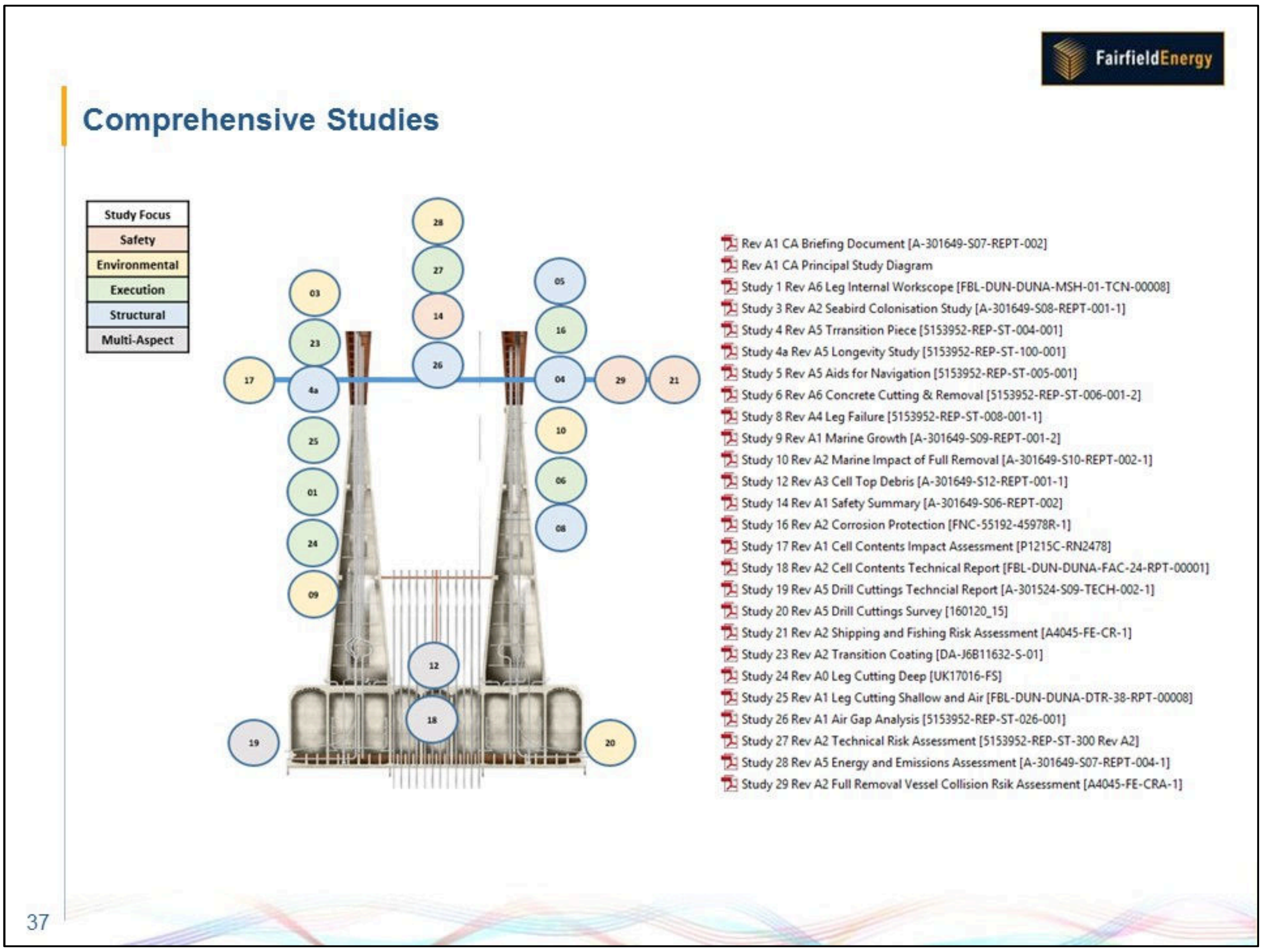
Option 9 is the '**Transitions Up**' option. This would be a derogation option.
It is based on a methodology of protecting the transitions though coatings & cathodic protection.

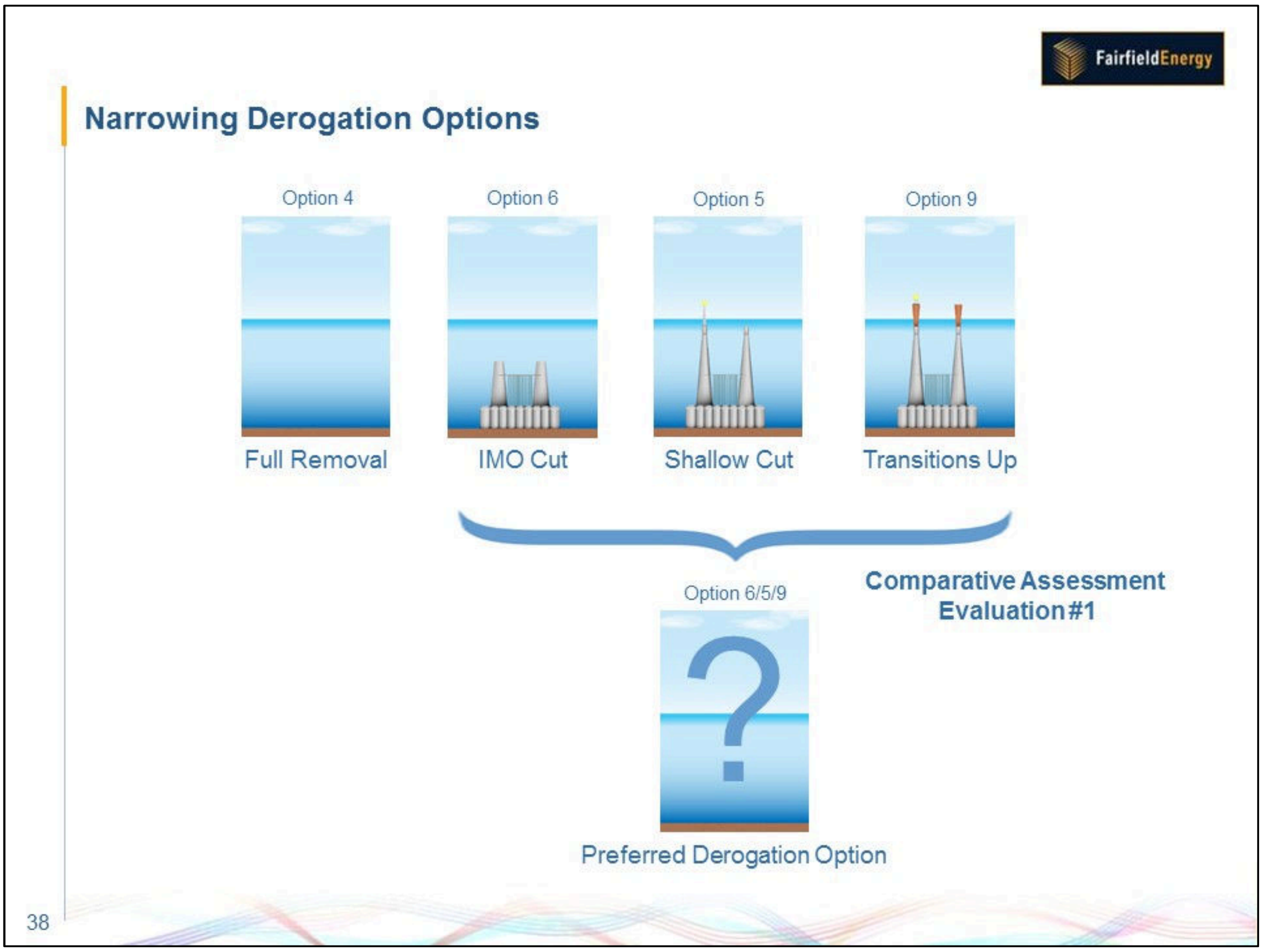
Transitions scopes would be completed alongside the common scope.
Internal coatings would be applied to the inner surfaces.
Anodes would be applied externally – likely in a clam-shell arrangement around each leg.
Each of the steel transitions would project through the water surface.
Each transition would be capped and one transition would carry an Aid to Navigation.



Extensive studies have been undertaken to support the Evaluation Phase for the four screened options.

In summary, these studies have looked at:

- Safety aspects of executing each option – workhours, durations, accident rates
- Safety of other users of the sea during execution, such as collision risks
- Legacy safety risks such as snagging risks for fisheries or collision risks for marine vessels in general
- Environmental impacts from executing each scope – marine noise, emissions, energy use
- Legacy marine impacts, including ultimate fate of the structure and its contents
- Execution issues, including the technical risks inherent with each option
- Structural issues, including longevity and failure modes of the structures
- Societal impacts of each option such as job creation, waste generation and impact on commercial fishing



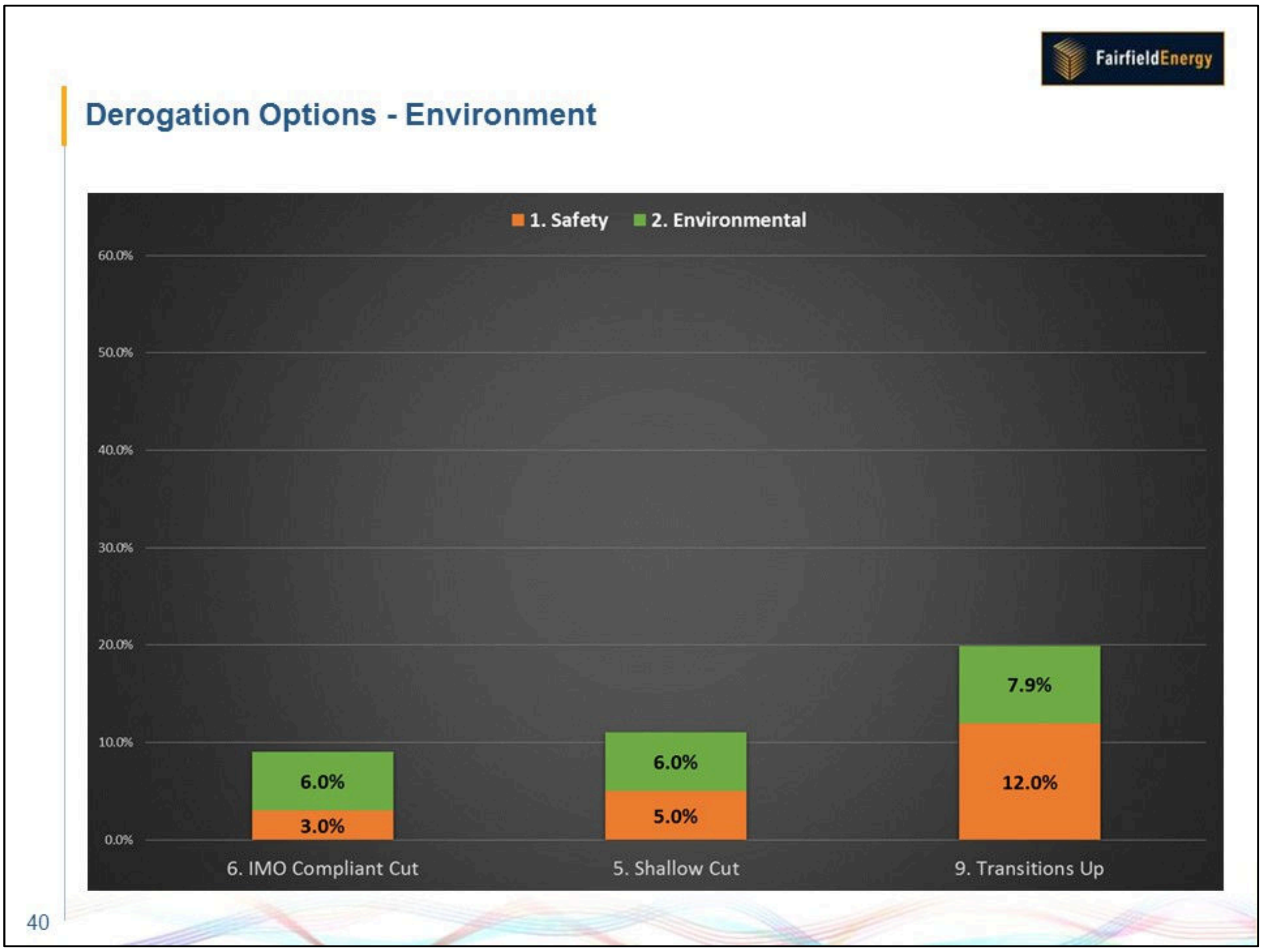
Our approach to the Evaluation Phase for the CGBS has been two step.
The first step was to determine the preferred derogation option.
The second step was to comparatively assess the full removal option with the preferred derogation option
First step was therefore the Comparative Assessment of ‘IMO Cut’, ‘Shallow Cut’ and ‘Transitions Up’
The following slides summarise the results of the evaluation.

Option 9 (Transitions Up) was assessed as the most preferred on the **Risk to Operations Personnel** criterion. This assessment was due to the risk exposure being much lower.

The assessment against the **Risk to Other Users** criterion is similar.

The differences between the options against on **Legacy Risk** criterion were smaller. This was reflected in the assessment. Options 5 and 9 were considered equally preferred as they carry lower legacy risk than Option 6 (dominated by snagging hazard).

Option 9 (Transitions Up) was assessed as the most preferred option against the Safety criterion.

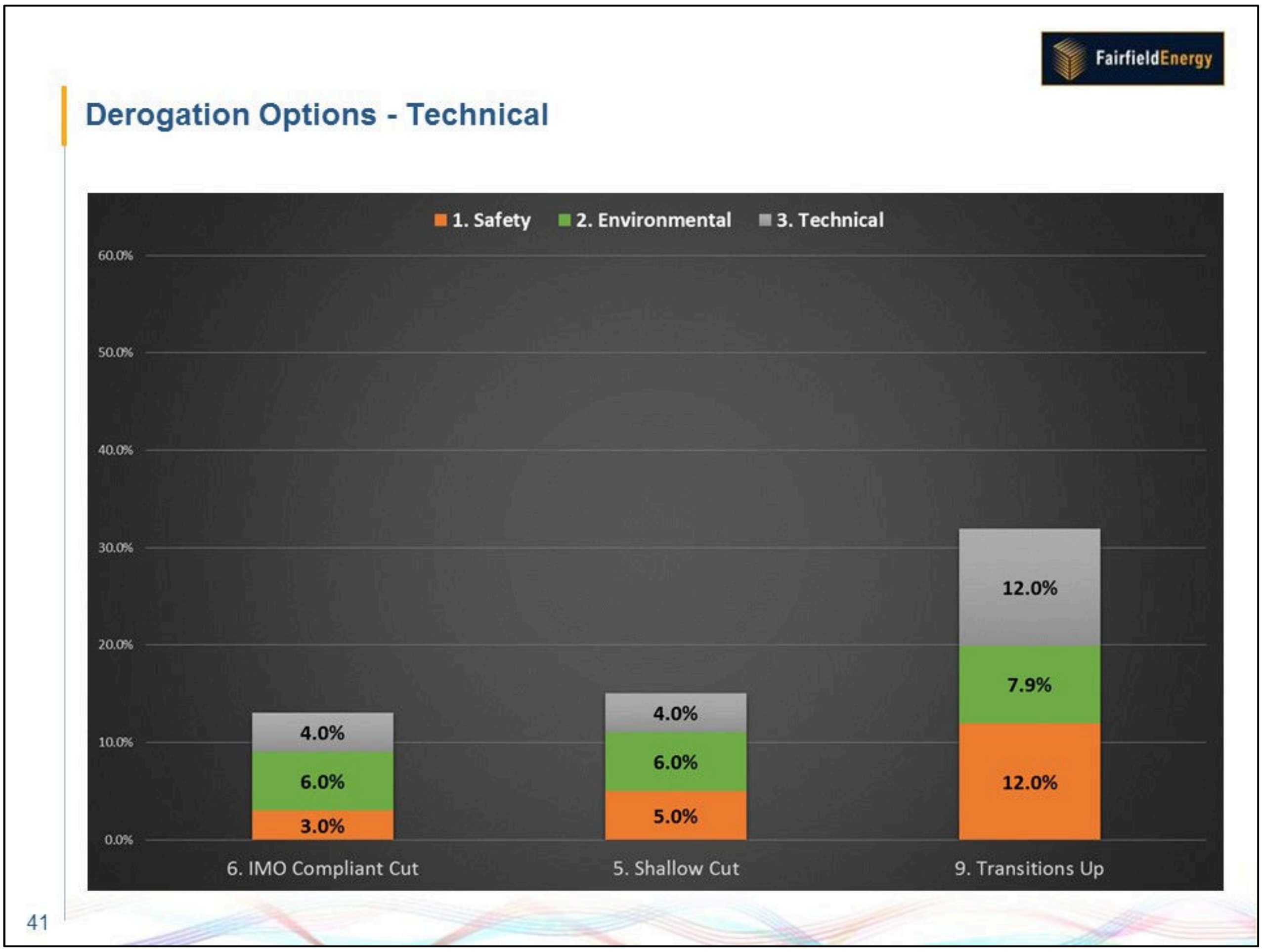


Option 9 was assessed as the most preferred option against the **Operational Marine Impacts** criterion.
Option 9 was considered stronger than Option 5 and Option 6 due to the significantly reduced potential for a dropped object (resulting from cutting and lifting operations) to redistribute drill cuttings and/or puncture the cells.
Option 9 also has limited noise disturbance due to the lack of cutting operations.

Option 9 is also assessed as the most preferred option against the **Atmospheric Emissions & Consumption**s criterion.
Option 6 and Option 5 were considered similar but Option 9 has sufficiently lower emissions & fuel use to make it preferred.

All options were assessed as equal on **Legacy Marine Impacts** criterion as all options have the same residual inventory.

Option 9 (Transitions Up) was assessed as the most preferred option against the Environment criterion.



Option 6 (IMO Cut) has the significant technical challenges associated with performing large scale, unproven subsea concrete cutting operations.

Option 5 (Shallow Cut) has similar but smaller technical challenges for the subsea concrete cutting (although still unproven).

It does have the added challenge of developing and installing a concrete structure to hold the required NAVAID.

This structure must withstand the environmental forces in the splash zone and have longevity similar to the concrete leg.

This is exacerbated by the potentially performing the cut at 20m below LAT and the loss of the ring beam in the cut leg.

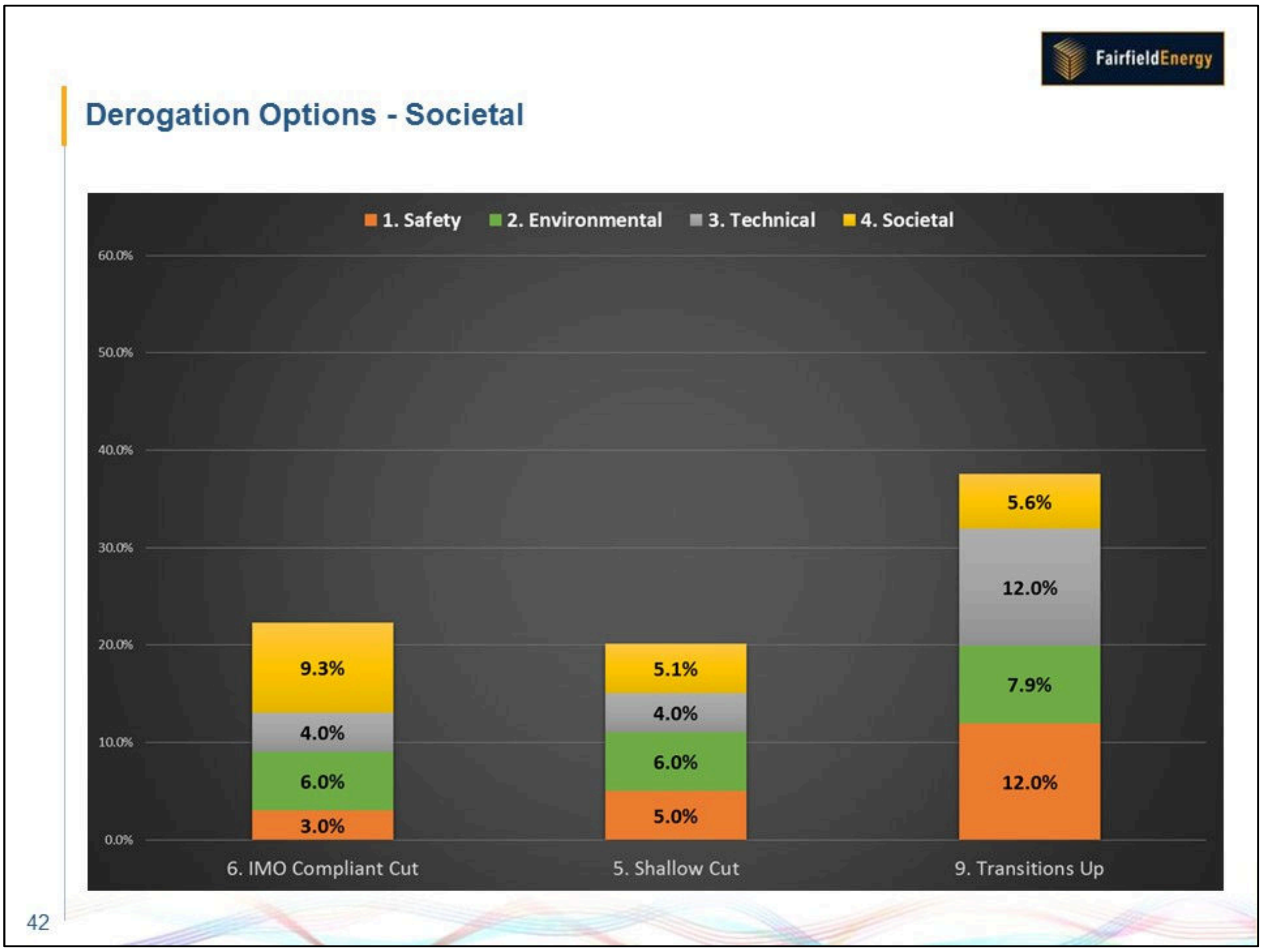
There are limited technical challenges associated with Option 9.

The leg preparation works (internal coating and installation of a cathodic protection system) are considered largely routine activities.

Option 9 (Transitions Up) was assessed as the most preferred option against the Technical criterion.

Note: The Technical Risk Assessment was updated after the CA Evaluation Workshop.

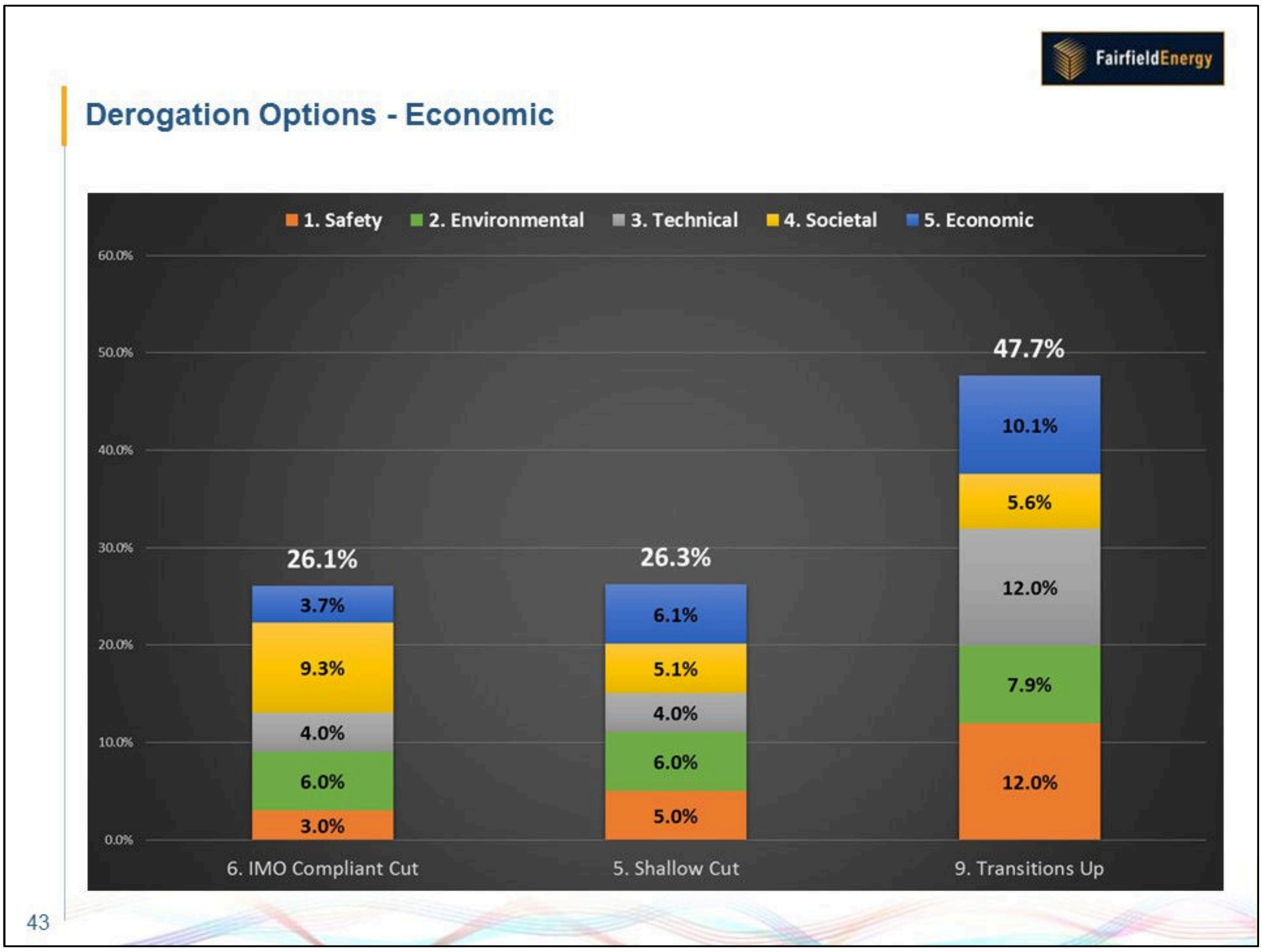
The changes were insufficient to alter the evaluation of the options against the Technical criterion conducted during the workshop.



Option 6 (IMO Cut) was assessed as the most preferred option against the **Fishing Industry** criterion.
This is due to the removal of the Safety Zone under Option 6 and thus the full area is returned to fishing use.
Under Options 5 and 9, the Safety Zone would be retained, precluding the return of the area to fishing.
There are submerged potential snagging hazards associated with Option 5 making this marginally less preferred than Option 9.

All options are assessed as being similar against the **Societal – Other Groups** criterion.
This is due to the benefits of job creation / retention being offset by the processing of returned concrete.
The returned concrete is challenging to re-use and may well end in landfill – believed to be a diminishing waste destination.

Option 6 (IMO Cut) was assessed as the most preferred option against the Societal criterion.

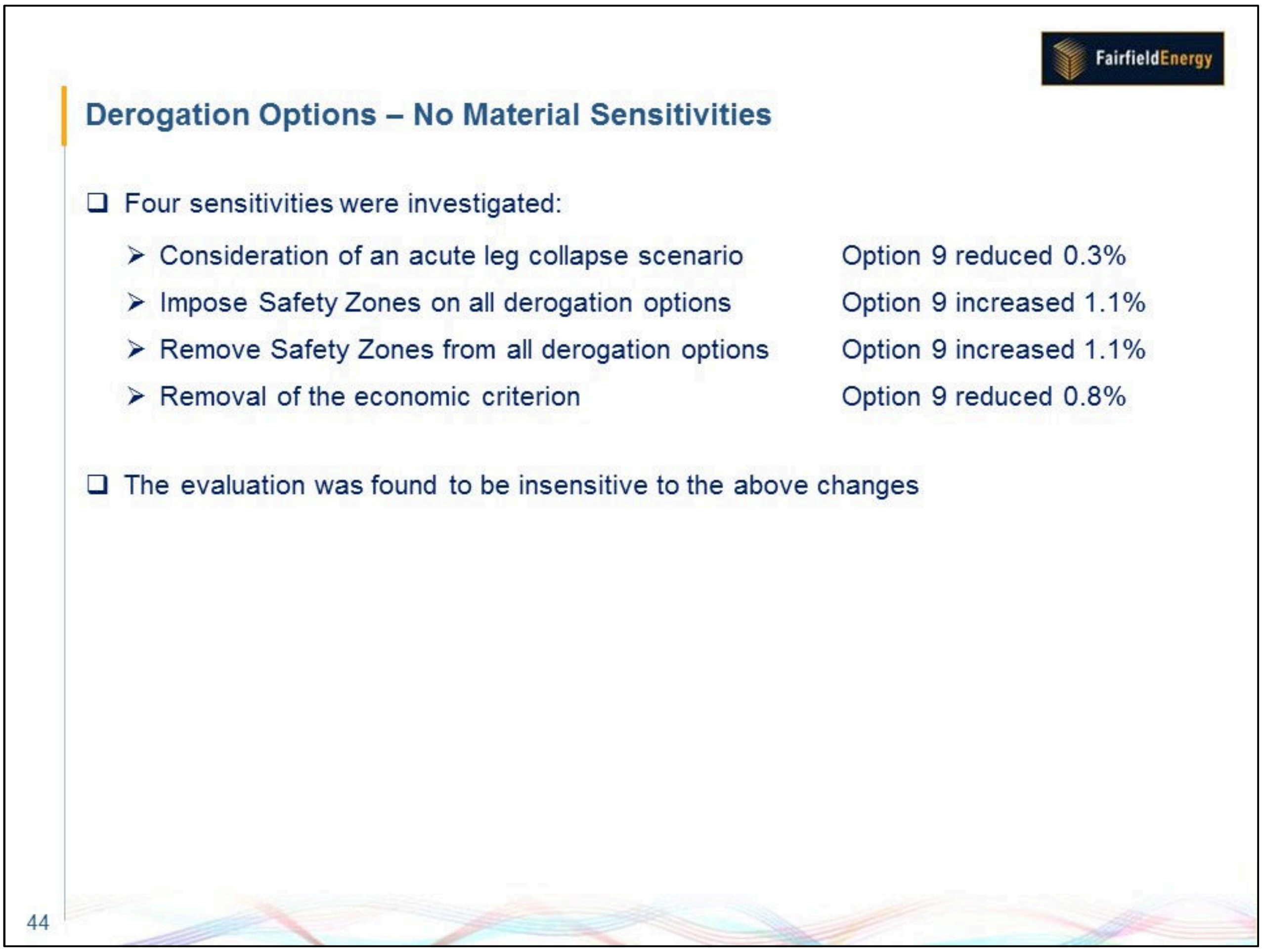


Option 9 (Transitions Up) was assessed as being the most preferred option as it has the lowest estimated costs.
Option 5 is next with the cost being around 2.5 times higher.
Option 6 is the least preferred with the costs being around 5 times higher than Option 9.
It is noted that Option 5/9 have a legacy cost associated with NAVAID maintenance whereas Option 6 does not.

Option 9 was assessed as the most preferred option against the Economic criterion.

Overall, Option 9 was assessed to be the preferred option against the Safety, Technical and Economic criteria.
It was also the preferred option against the Environmental criterion, although the preference was less pronounced.
Option 9 was not the preferred option against the Societal criterion (this was Option 6).
This was not enough to offset the preferences under all other criteria.

Option 9 (Transitions Up) was the most preferred of the potential derogation options.



The stakeholder discussion at the Evaluation workshop generated a number of requested sensitivity analyses.

Leg Failure

The ultimate failure mode of concrete legs left in-situ is expected to be spalling of relatively small sections over a prolonged period.

A sensitivity was performed to assess the scenario of an acute leg failure impacting the cell tops and causing an acute release of the contents.

Modelling demonstrated the environmental impact of such a release scenario was low.

Option 6 strengthened slightly (in comparison to the others options) under this sensitivity but Option 9 reduced by less than 1%.

Safety Zones

The initial evaluation assumed a Safety Zone for proposals that would breach the water surface, and no safety zones for below surface options.

This Safety Zone assumption has an impact on legacy safety impacts (snagging hazards) and societal impacts (commercial impact on fishing).

Two sensitivities were performed – (a) impose a Safety Zone on all options and (b) remove the Safety Zone from all options.

Imposing a Safety Zone directionally strengthens option 6 in terms of legacy risk, but it loses more due to loss of commercial fishing benefits.

Net effect of imposing a Safety Zone on all options is that option 6 is diminished relative to options 5/9. Option 9 increased by ~1%.

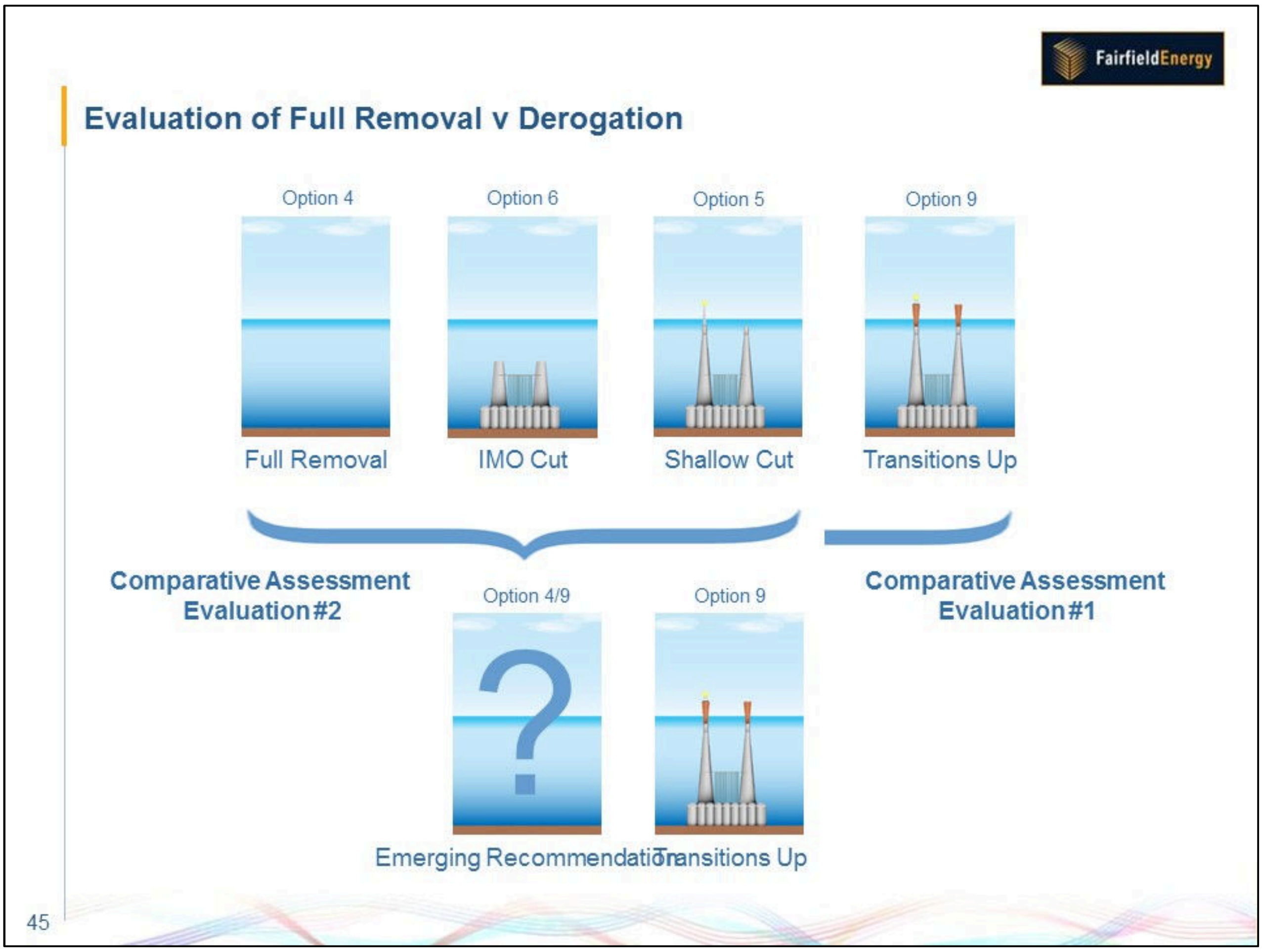
Removing the Safety Zone from all options directionally weakens option 5/9 in terms of legacy risk, but they gain more in commercial fishing impacts.

Net effect of removing all Safety Zones is that option 6 is again diminished relative to options 5/9. Option 9 increased by ~1%.

Removal of Economics

To remove cost bias, we performed the typical sensitivity of disregarding all costs associated with the options.

Option 9 diminished by less than 1% and remained the clear preferred derogation option.



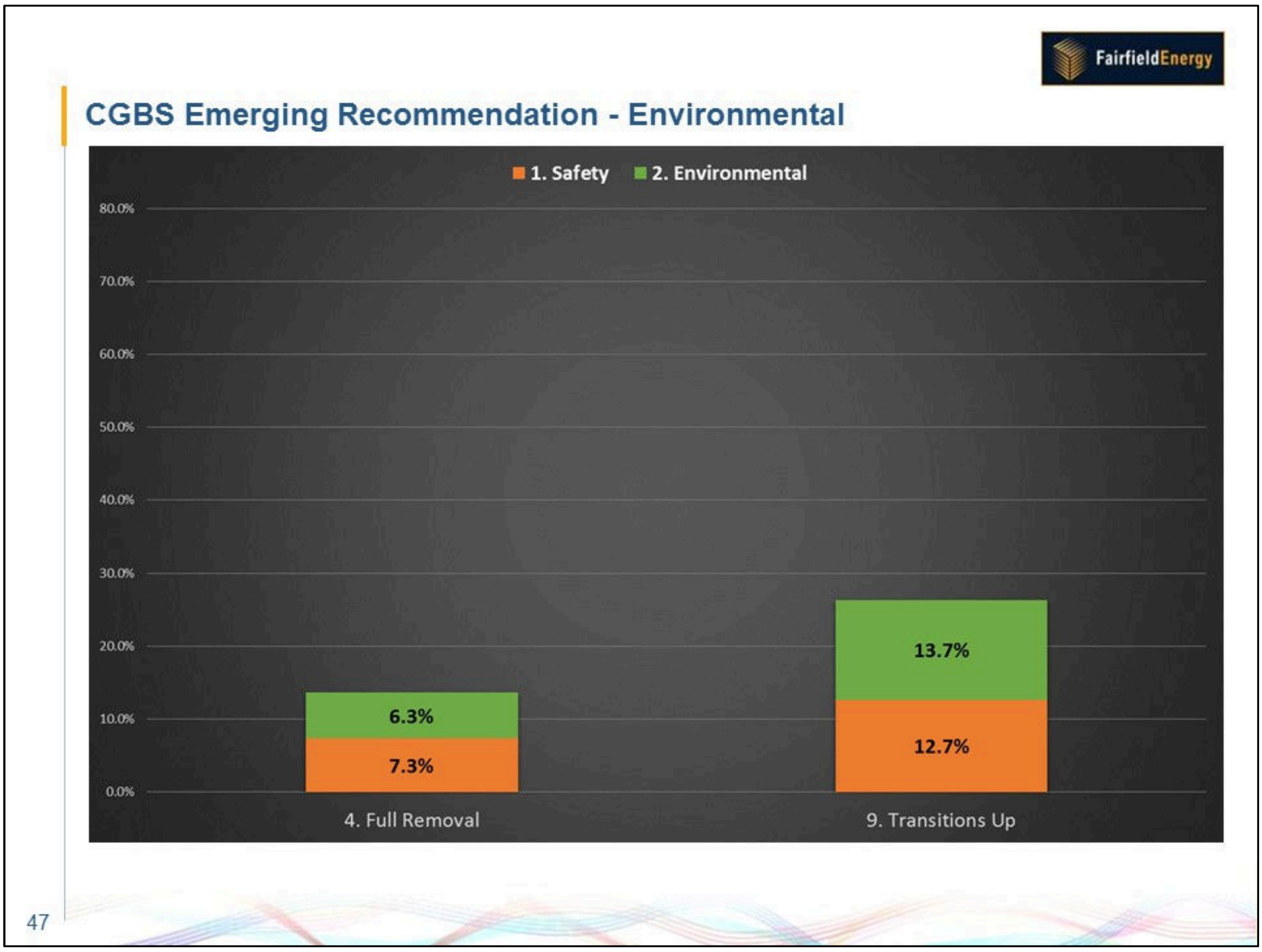
The second step was to comparatively assess the Full Removal option with the preferred derogation option, namely 'Transitions Up'.
The result of this evaluation would be considered the **Emerging Recommendation** for the CGBS.

Option 9 (Transitions Up) was assessed as the most preferred on **Risk to Operations Personnel** criterion. This assessment was due to the risk exposure being around 300 times lower.

Option 9 (Transitions Up) was also the most preferred against the **Risk to Other Users** criterion. This assessment was due to duration of operations being around 800 times lower.

Option 4 (Full Removal) was the most preferred against the **Legacy Risk** criterion. This was because there is no legacy risk associated with the full removal option.

Option 9 was assessed as the most preferred option against the Safety criterion.

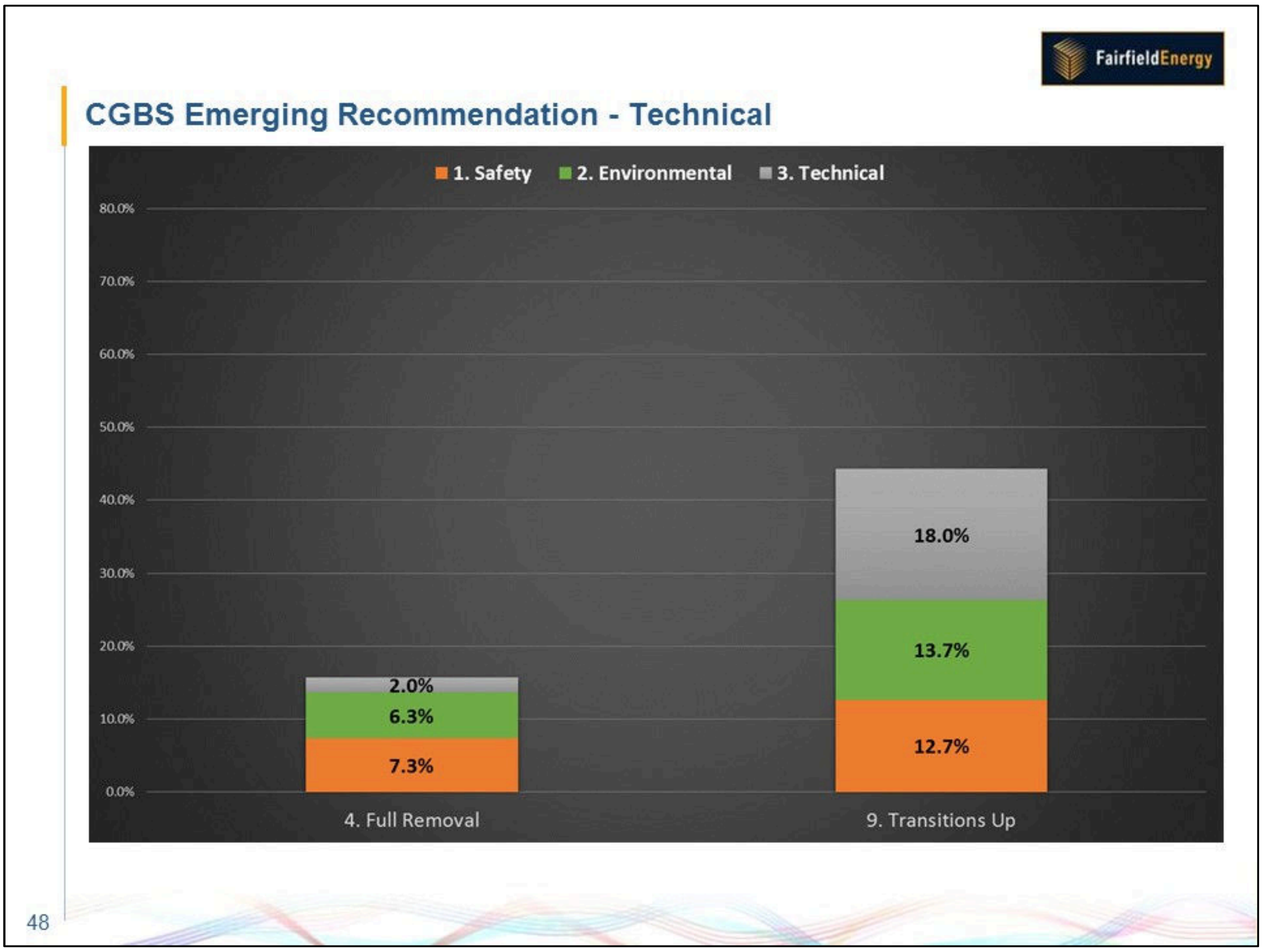


Option 9 (Transitions Up) was assessed as the most preferred option against the **Operational Marine Impacts** criterion. This was due to the potential marine impacts from the in-situ deconstruction of the cell base, the removal of the contaminated drill cuttings and the impact in the benthic environment from performing the Full Removal option over many years (decades).

Option 9 was also assessed as the most preferred option against the **Atmospheric Emissions & Consumptions** criterion This assessment was due to the emissions being around 700 times lower.

Option 4 (Full Removal) was assessed as the most preferred option against the **Legacy Marine Impacts** criterion.
This was due to the full removal option eliminating the majority of legacy impacts.
It was noted that there is a legacy impact to the benthic environment from performing Option 4 over many years (decades).
There is also a minor benefit from the 'artificial reef' principle associated with Option 9.

Option 9 (Transitions Up) was assessed as the most preferred option against the Environment criterion.



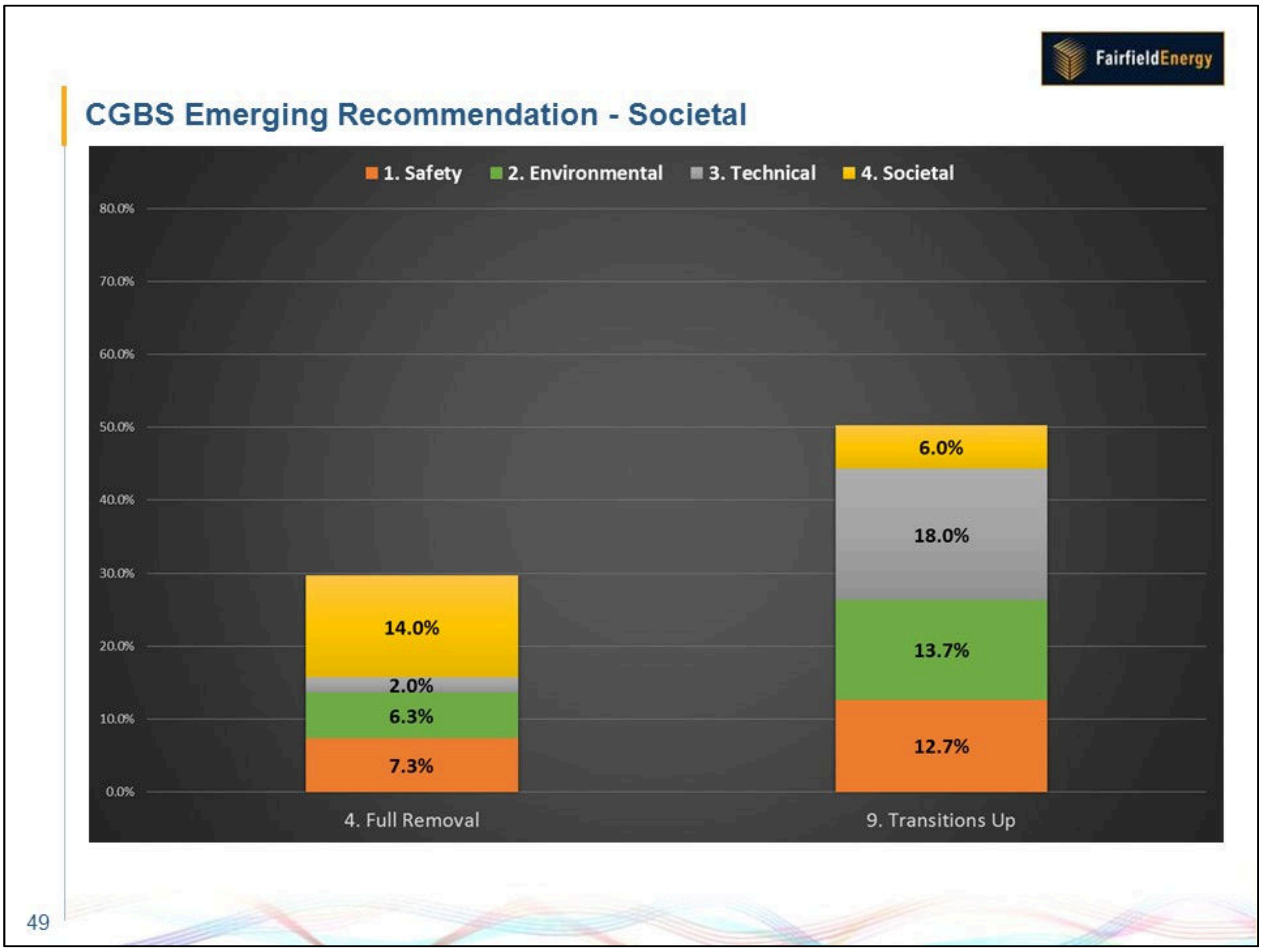
Option 4 (Full Removal) has significant technical challenges associated with performing large scale, unproven subsea concrete cutting operations.

Further challenges include the in-situ deconstruction of the cell base, and limiting releases of cell contents to the environment.

There are limited technical challenges associated with Option 9.

The transition preparation works (internal coating and installation of a cathodic protection system) are considered routine.

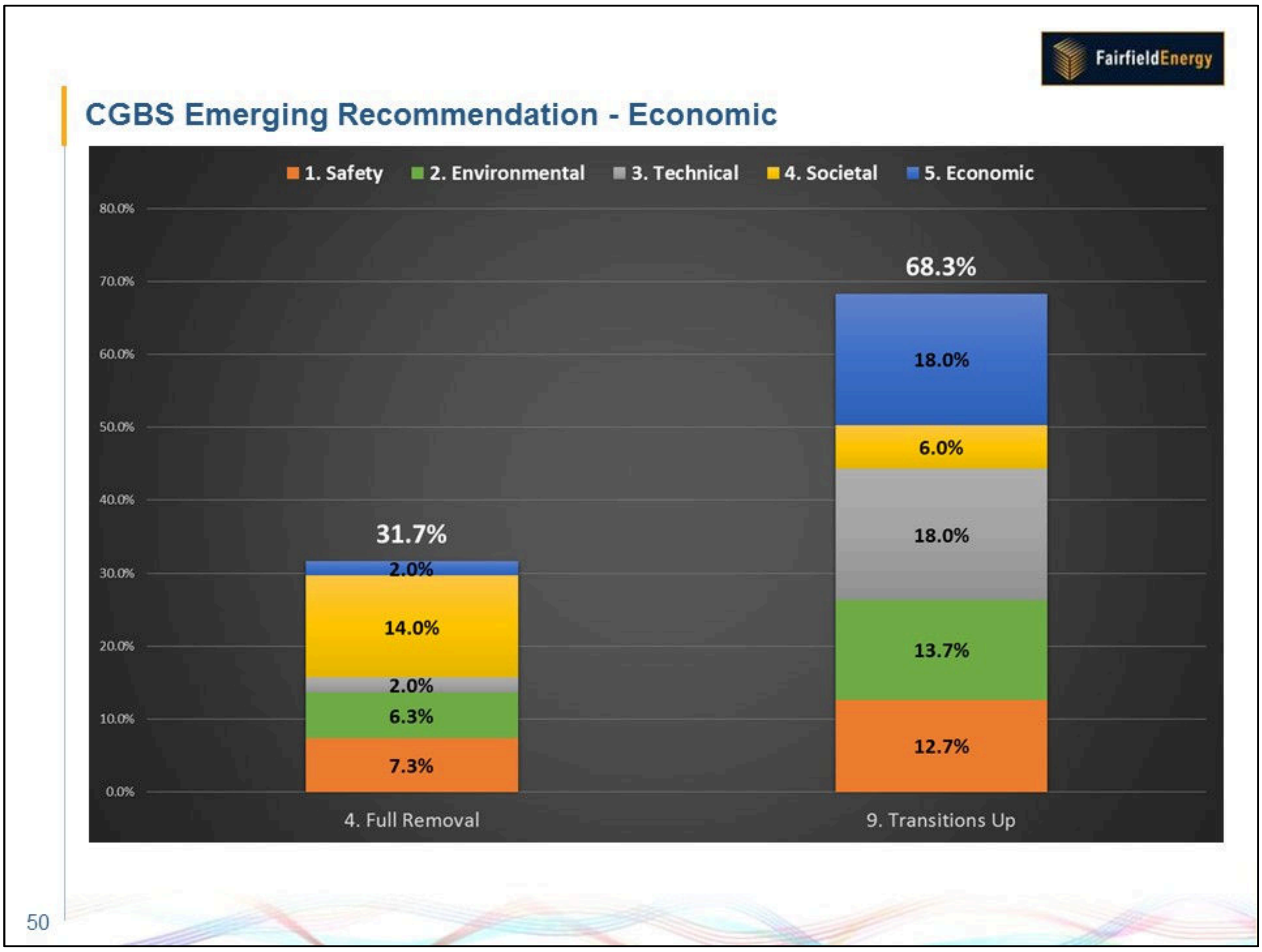
Option 9 (Transitions Up) was assessed as the most preferred option against the Technical criterion.



Option 4 was assessed as the most preferred against the **Fishing Industry** criterion.
This was due to the Full Removal option returning the entire area to commercial fishing use.

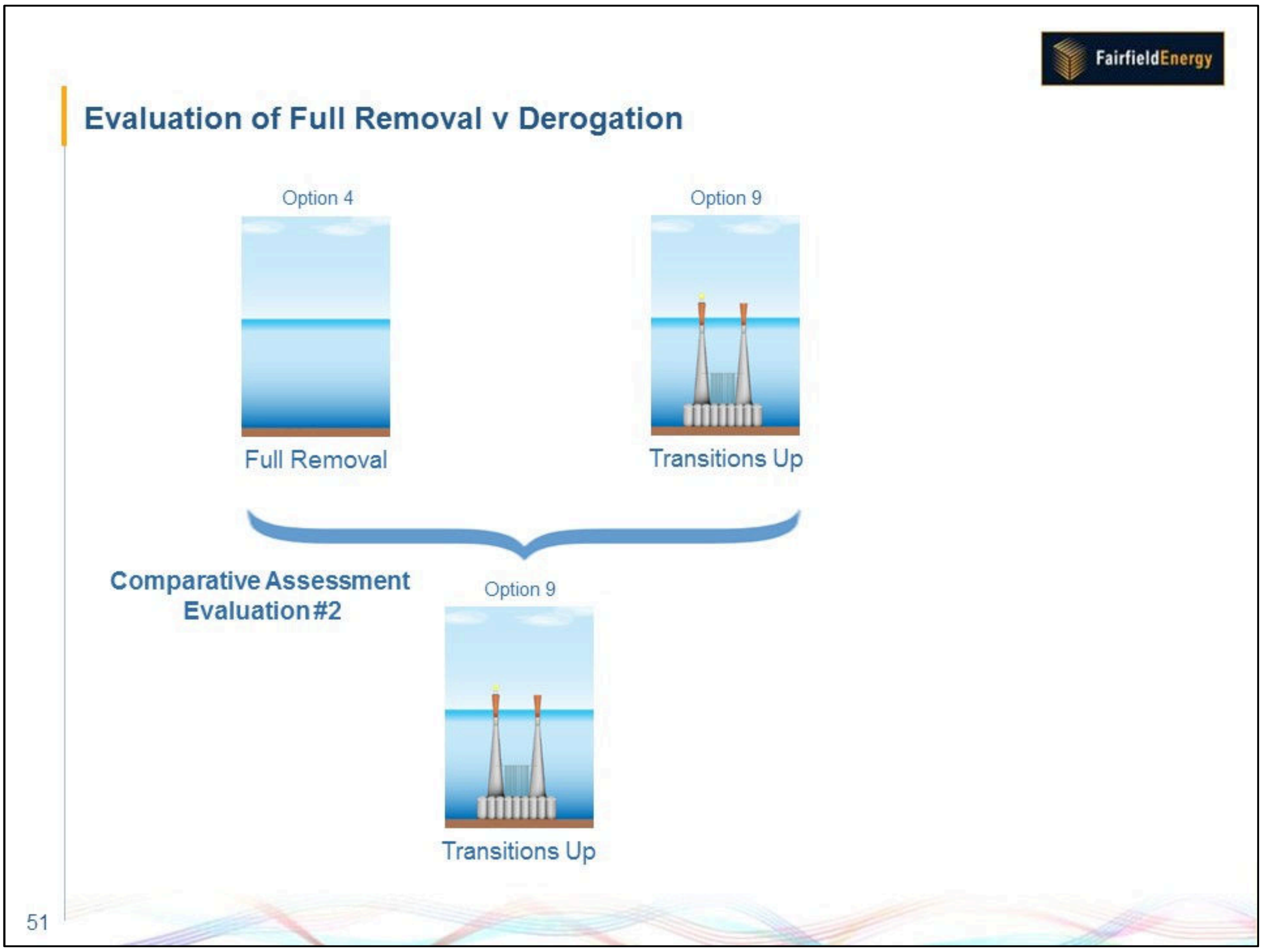
Option 4 and Option 9 are assessed as being similar against the **Societal – Other Groups** criterion.
This is due to the benefits of significant job creation / retention associated with Option 4 being offset by the negative aspects relating to the processing of hundreds of thousands of tonnes of returned concrete.
The returned concrete is challenging to re-use and may end in landfill.

Option 4 (Full Removal) was assessed as the most preferred option against the Societal criterion.



The estimated costs of Option 9 are around 200 times lower than Option 4.
It was noted that Option 9 has a legacy cost associated with NAVAID maintenance.

Option 9 was assessed as the most preferred option against the Economic criterion.



The result of the above evaluation was that the derogation option of Transitions Up was strongly preferred in four of the five principal criteria.

Perceived benefits of Full Removal option were limited to restoring the footprint of the CGBS to commercial fishing exploitation.

All other criteria and sub-criteria were either neutral or in favour of the derogation option of retaining the transitions and decommissioning the structure in-situ.

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Emerging Recommendation – No Material Sensitivities

- One additional sensitivity, removal of the economic criterion, reduced Option 9 by 5.4%
- The emerging recommendation was found to be insensitive to the above change

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One additional sensitivity was performed at this stage – removal of the economic criterion.
This reduced Option 9 by approximately 5%, changing the outcome from 68/32 in favour of Option 9 to 63/37.

The evaluation was therefore considered robust against the considered sensitivities.

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Emerging Recommendation for CGBS

Method Statement

1. Plug and Abandon the Platform Wells
2. Make Safe the Topsides
3. Remove Hazardous Material from Legs
4. Apply Internal Coatings to the Transitions
5. Add external Cathodic Protection to the Transitions
6. Cap the Top of the Transitions and Remove Topsides
7. Add Aid to Navigation (AtoN) Facilities to Leg C or Leg D
8. Maintain AtoN Facilities until inhibited by Degradation

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The Emerging Recommendation for the Concrete Gravity Based Structure is to retain the four transitions through the water surface.
This option would require a derogation to OSPAR 98/3.
An Aid to Navigation would be installed on one of the capped transitions.
The NAVAID would be regularly maintained and periodically changed-out for the foreseeable future.
A program of structural inspection/monitoring would be agreed with the regulator as part of the approval process.

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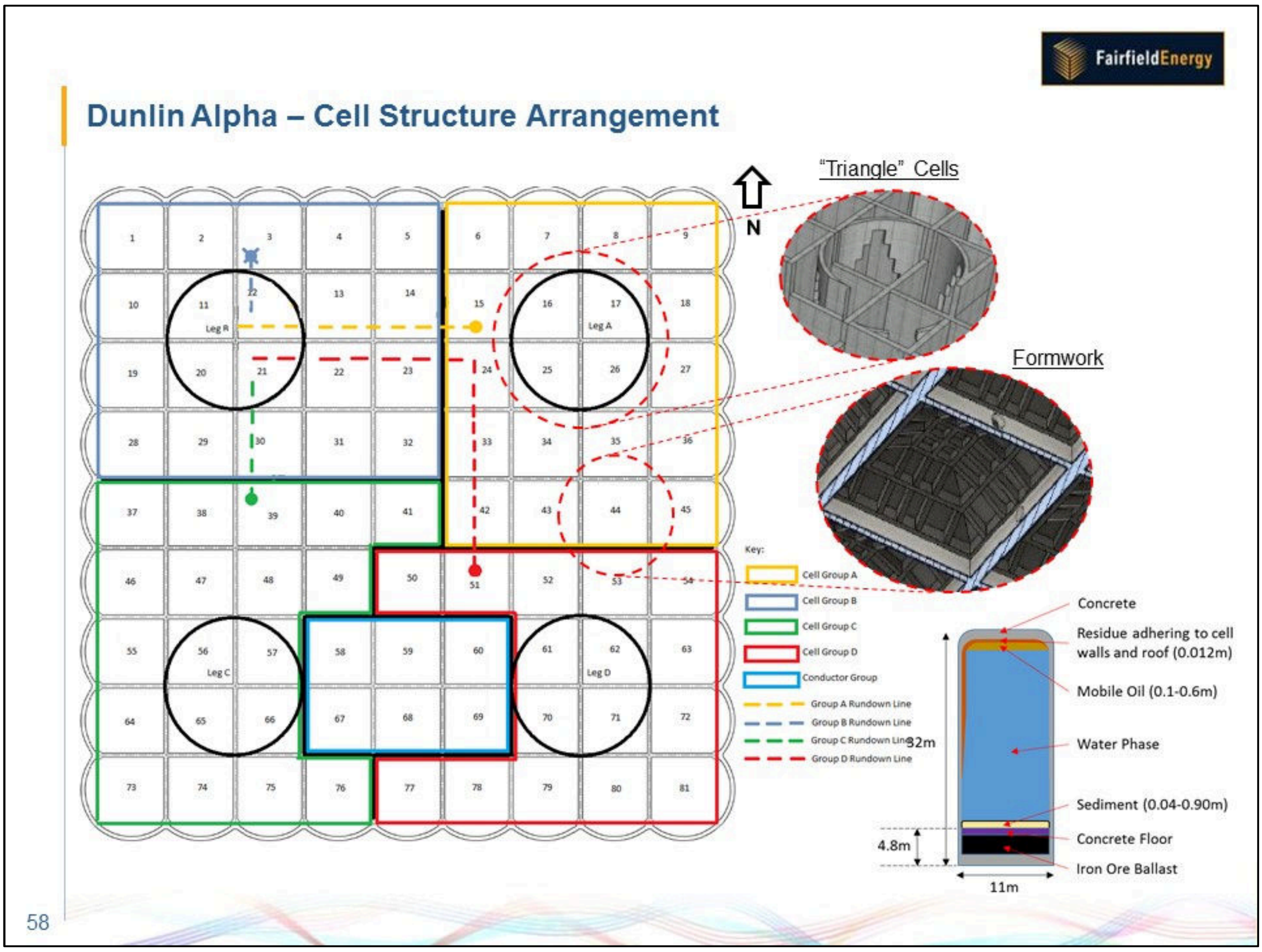
Emerging Recommendation for Cell Contents

Caroline Laurenson



Recap on the overview that was provided at the last session in relation to our understanding of the residual cell contents.

This a plan view of the cell layout and main rundown line pipework that delivered production fluids into the cells.

From our study work this has built up in inventory of the quantity, composition and location of the residual materials within the cells.

Within each cell there are four distinct phases of material – oily sediment accumulated on the floors, waxy residue adhered to the walls, a thin layer of mobile oil in the cell roof space and the remainder of the available space is filled with water.

If I now take you through how the inventory is distributed across the cells:

- Oil was recovered during the Attic Oil Recovery Project (AORP) executed by Shell in 2007, this left a thin, approximately 10cm, layer of oil across all the cells.
- Sediment is unevenly distributed across the cells, with 8 cells worse affected. This has been estimated by understanding the settling characteristics of the particulate solids and from this our understanding is that they will be concentrated in the first and second cells where the rundown lines enter the cells.
- Wax is deposited on the internal surfaces of the walls on the outermost cells and the cell tops. This is because wax deposition is driven by temperature differences between the internal and external environments.

Our investigations into the design of the structure have highlighted the following features that have a significant influence on the distribution of the mobile oil.

- Underneath the leg structure at the four corners of the cells, there is a supporting foundation that builds up to support the circumference of the leg that sits on top of the CGBS cell base. This has created "triangular" shaped pockets of trapped oil that would not have been displaced during the Attic Oil Recovery Project.

-The residual oil that now sits in the cell tops is further compartmentalised by what is called "Formwork". This formwork is a 6by6 lattice and was used to support the concrete domes as they were constructed.

Cell Contents Scoping Considerations

Cell Access
× Existing pipework
✓ New penetration in cell top
× New penetration in cell side wall

Contents Management
✓ Removal
× Bioremediation
× Capping
✓ Leave In Situ

Target Phases
✓ Mobile oil
✓ Sediment
× Wall Residue
× Water Phase

Waste Handling
✓ Ship to Shore
× Inject to Well
× Onsite Treatment

Target Cells
✓ All of the cells
✓ Selected cells

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Based on the inventory we have examined potential management options. This slide provides an update on the work that has been carried out to scope and screen the cell contents management options.

We built-up an understanding of the important influencing factors for the project and from this used a series of questions to frame the options.

<u>How will the residual cell contents be accessed?</u>
Our review of access options from the topsides via the existing pipework, showed that only the rundown lines, risers and j-tubes may be feasible. These options have been further pursued as part of the survey and sample scopes. However, a number of challenges have been encountered during the offshore operations:

High pressures (of up to 4 bara) in the rundown lines.
High H2S concentration.
Wax pellets creating a blockage to flow in the STATS umbilical (in rundown line B).
Presence of inhibitor gel potentially blocking the rundown lines.
Measurement resolution of the survey tooling to look through the pipework.

This makes it highly unlikely that these access points would be suitable for a scope involving more intrusive operations to recover large volumes of materials.

The Enpro technology to create a new access point on the tops of the cells is tried and tested and therefore this is our option basis, this is in preference to developing the concept to create new side wall access points, which has never been done before in the marine environment.

How will the residual cell contents be managed?
We considered four primary options ranging from removal, treatment by bioremediation, capping to encapsulate the sediment through to leaving the residual contents in situ to naturally degrade over time. All the intervention options require new cell top access points to be created. This is proportionally the highest cost element of the operations. The efficacy of the bioremediation and capping options are uncertain with neither being tested in this environment and our logic was that if you are required to access the cell, the recovery option gives the highest guarantee that a further reduction in the contents can be achieved along with tangible evidence of the results.

Further to this, when we examined the bioremediation option we found that this option may not be effective in the deeper layers of sediment material and the conditions within the cells, cold, no light or oxygen, a slightly acidic pH, would limit the rate of biological activity. While there are some extremophiles that can cope with conditions such as this, the option to use genetically enhanced organisms was ruled out. It is highly likely the organisms would require replenishment in the future, meaning further resources and vessel activity for this option. It is also important to note that this option would not do anything to remove the heavy metals and could in fact make them more bioavailable.

For the capping option it is a similar story. The main benefit of this option is that it would provide a secondary barrier to prevent hydrocarbon release from the sediment materials. This would effectively prevent mass transfer of the hydrocarbon components into the mobile oil phase at the tops of the cells, therefore increasing the volume of oil potentially released in the event of a breach through the structure. It could also reduce the rate of release from the sediment upon eventual degradation of the structure, however as the structure degrades, concrete material will fall in on itself resulting in a natural capping effect on top of the sediment.

At this point I would like to highlight that the basis for the inventory focusses on the characteristics of the residual materials within the cells as of today, it would be beneficial to enhance understanding of how characteristics may change over time, with two key parameters being further researched. This has been as a direct result of our investigations into the potential management options, where we felt it would be beneficial for industry to better understand the nature of the materials.
The two areas still being reviewed are:

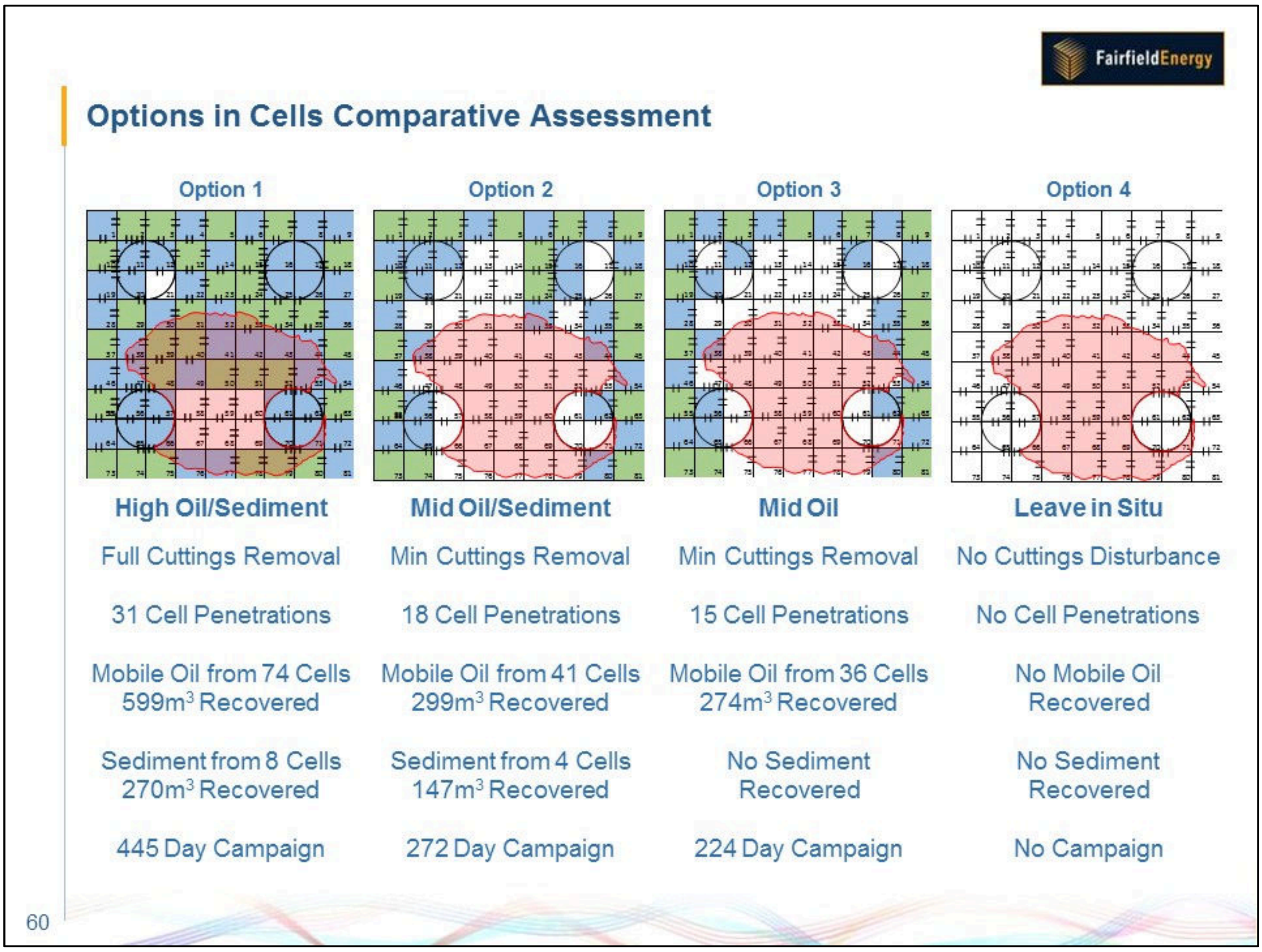
- Natural degradation of the hydrocarbons due to bacterial activity.
- Hydrocarbon diffusion from the sediment and wall residue into the water and mobile oil phases.

Which phases of material will be targeted?
The project has examined the estimated time to recover of each of the phases, to demonstrate whether execution of the project would in a reasonably achievable timeframe. What we found was that the mobile oil and sediment is likely to be recoverable in a reasonable timeframe, up to the order of months. But the wall residue would be significantly longer due to the large surface area to be cleaned and the access limitations. The water phase makes up the bulk of the residual inventory, this water contains low levels of hydrocarbons and heavy metals. As the system is required to remain liquid filled, the methodology to extract the water involves simultaneous removal of fluids with fresh seawater replacing the fluids that are extracted. This is a time consuming operation as the full volume of the cells would need to be displaced multiple times to reduce the level of contaminants within the water and it may be difficult to demonstrate the point at which sufficient improvement had been made.

How will any waste created/recovered be managed?
We examined the expected quantity of waste materials and the nature of the materials to decide what the most appropriate solution would be. As the operations to recover the contents will be carried out post down-manning/removal of the topsides, the option to use the existing disposal well would not be feasible and utilising a subsea well would require transportation and equipment to transfer the waste to the disposal location. The volume of oil is relatively small and would be more appropriate to be placed in ISO containers and returned to shore for treatment and re-use. Previous projects have shown that onsite treatment of sediment is extremely challenging and again due to the relatively small volumes of materials this would be more appropriately handled by shipping to shore.

Which cells should be targeted?
At this point in the screening we felt it was important to retain both options and carry out a more detailed optimisation of effort versus recovery efficiency for the cell contents.

The result of all this option scoping and screening created over 70 options, with various different permutations of access points and amount of material to be recovered. This was further screened down to four options to go into the detailed evaluation phase of the Comparative Assessment.



I'll now take you through the characteristics of the four options. There is also a detailed fact sheet with more information about the evaluation basis for each option.

In the diagrams, the green cells are those which would have a new hub connection drilled through the cell top, the blue cells are those that then would be accessed from the hub cell and the white cells indicate no intervention or contents recovery. The pink cloud represents the footprint of main drill cuttings pile.

Option 1 was selected as it provided the highest recovery efficiency of both residual oil and sediment. However this option requires full removal of the drill cuttings pile in order to access the cell tops.

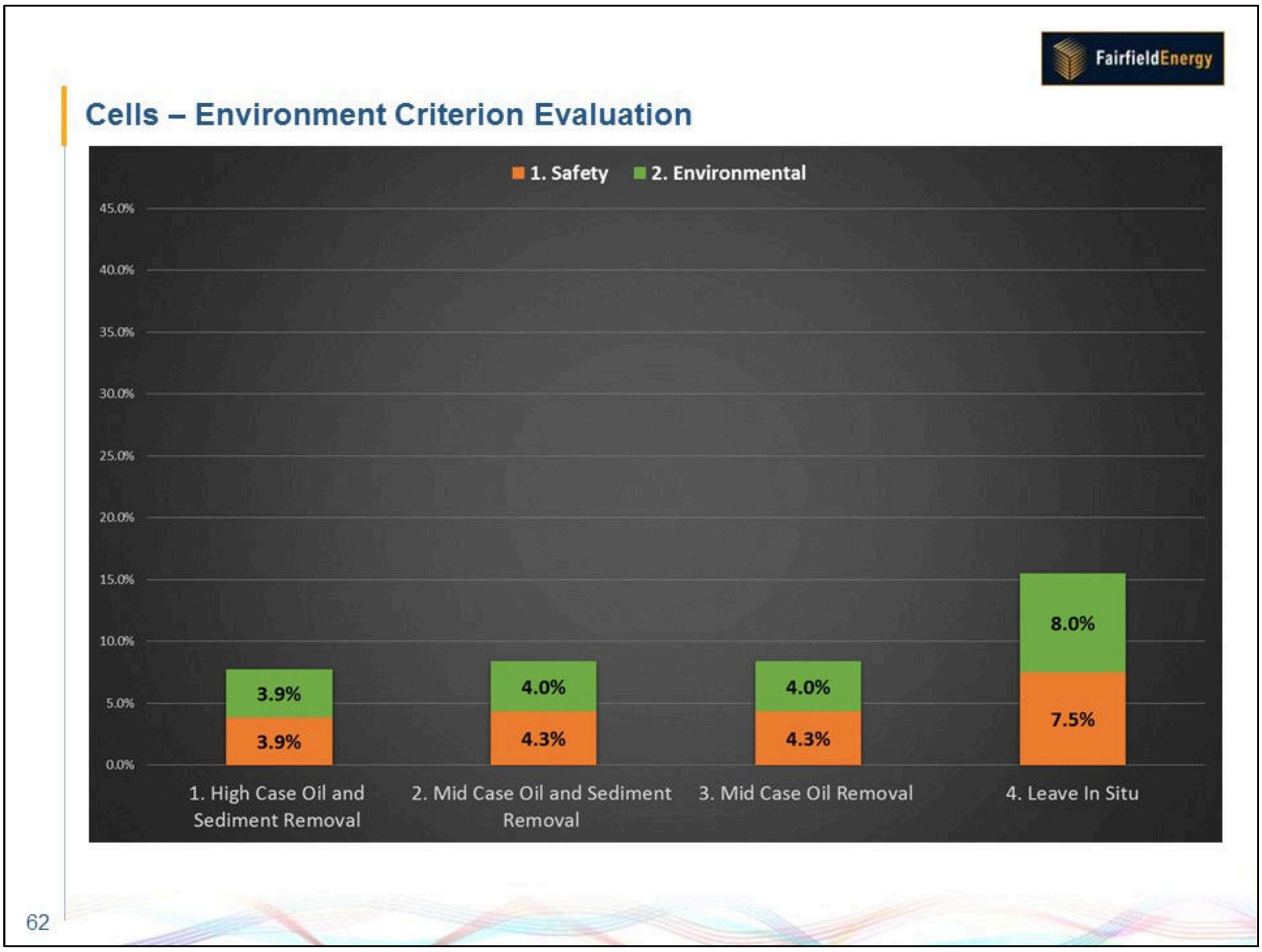
Option 2 was selected as a mid-case, where again both oil and sediment are targeted, but instead disturbance of the drill cuttings pile is kept to a minimum, by mainly targeting the peripheral cells outside of the main drilling cuttings pile footprint.

Option 3 represents a case where only residual oil is targeted, on the basis that sediment would be left in situ. As in Option 2, disturbance of the drill cuttings pile is kept to a minimum.

Option 4 depicts the leave in situ option, where it is proposed to leave the residual contents within the cell structure to naturally degrade.

The CA is evaluated using five primary criteria and I will now take you through the results of each of these.

The safety criterion has been evaluated using a PLL (or Potential for Loss of Life) industry safety metric based on activity durations and therefore man-hour exposure.
There were two sub-criteria:
Operational Personnel – The three contents removal options involve a long duration of offshore vessel based work, in the order or 200-400,000 man-hours, compared to the leave in situ option and were therefore the least preferred.
Legacy Impact - All options were assessed as equally preferred due to there being no legacy safety impact from any of the cell contents management options.

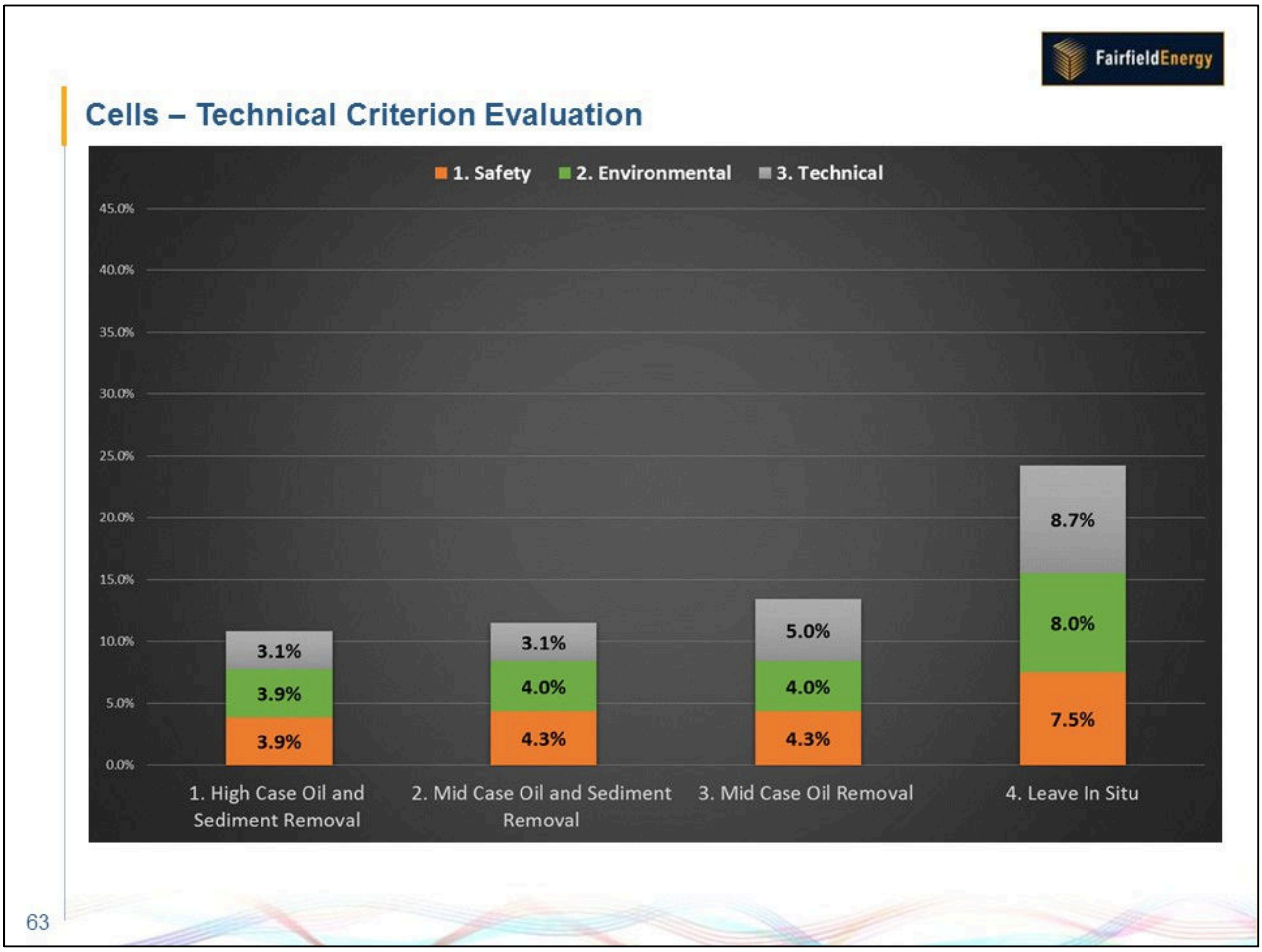


The environment criterion has been evaluated using input data from a few different areas, namely the volume of drill cuttings disturbance, the energy and emissions and the volume of hydrocarbons that will remain in situ upon completion of the option.

There were three sub-criteria:
Operational Marine Impacts - Disturbance of the drill cuttings pile in order to access the cells is not desirable due to potential for redistribution of the drill cuttings onto the seabed and release of contaminants into the water column. All three contents removal options involve disturbance of the drill cuttings on the cell tops making these the least preferred options.
Marine noise was not considered a significant differentiator, as for all options any effects will be below the damage threshold for marine mammals.

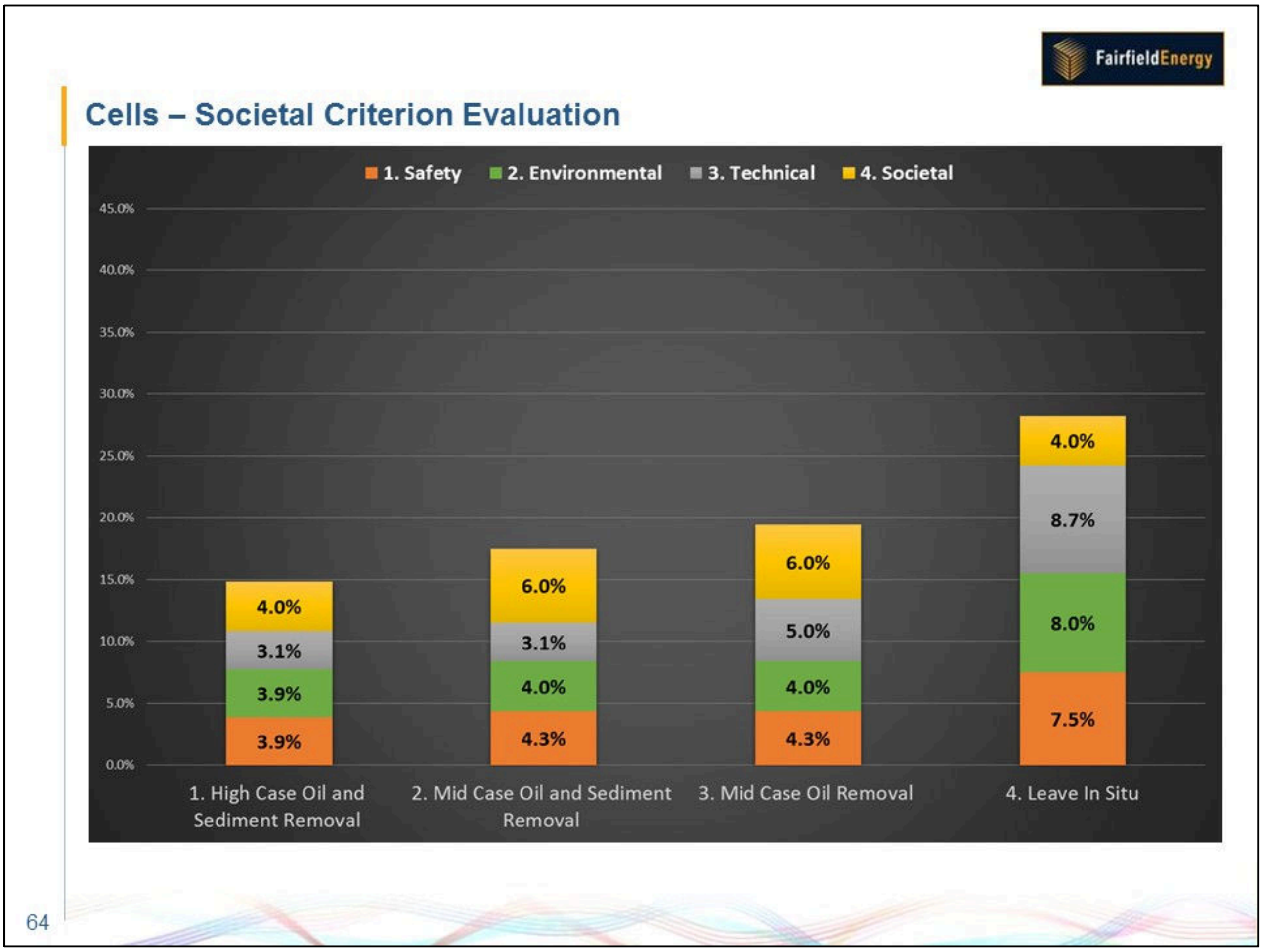
Energy & Emissions - None of the options have a particularly high contribution to atmospheric emissions on a global scale or in terms of climate change and are directly proportional to vessel activity durations and fuel use. All three contents recovery options involve a long duration of offshore vessel based work compared to the leave in situ option and are therefore the least preferred.

Legacy Impact - Our technical evaluation of the project has shown is would be difficult to recover 100% of the residual inventory and therefore all four options have a long-term environmental legacy impact. In assessing the environmental impact it was important to remember that the residual mobile oil inventory has already been significantly reduced by recovery of oil during the AORP in 2007.
Recovery of sediment is seen as a lesser importance to that of mobile oil, this is for two reasons firstly that the sediment inventory is relatively small and that upon loss of containment of the structure, the sediment is significantly less mobile. These factors limit the environmental impact associated with the sediment and mean that they are less significant than an oil release.
In the case of the mobile oil, the residual inventory is compartmentalised within the structure which both increases the complexity in recovery and limits the size of any instantaneous release, should the contents be left in situ.
Taking into account all of this the High Oil and Sediment Removal option was preferred as it recovers the highest proportion of the residual cell contents and also recovers all the drill cuttings from the cell tops.



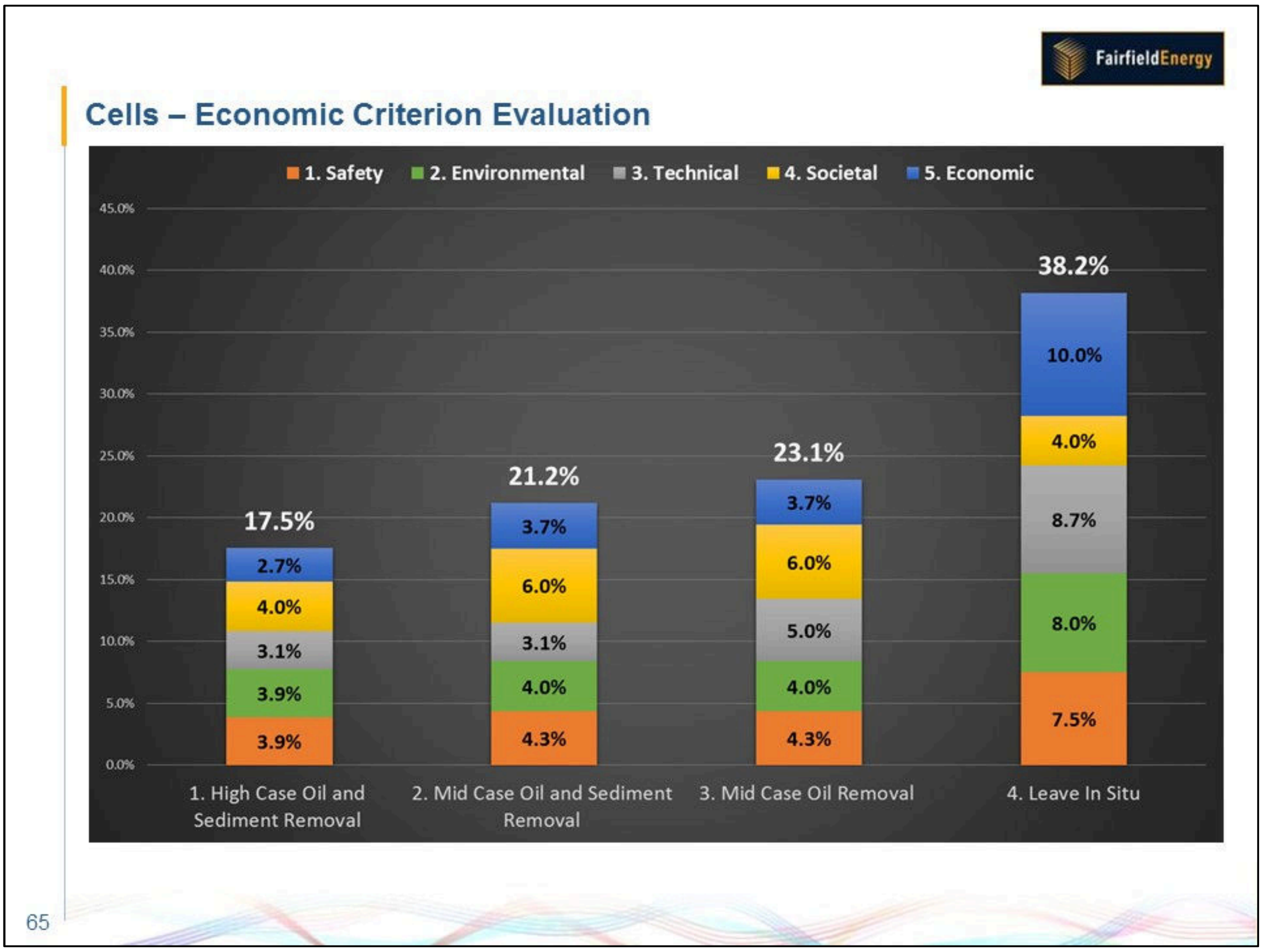
The technical criterion has considered the availability of technology, track record and likelihood of project failure.

There was only one sub-criterion:
Project Technical Risk - The technology availability and low likelihood of successfully recovering the sediment material makes the High Oil and Sediment and the Mid Oil and Sediment removal options least preferred.
The oil is compartmentalised both between the individual cells and within the cell top structure, making recovery technically challenging, making leave in situ the preferred option.



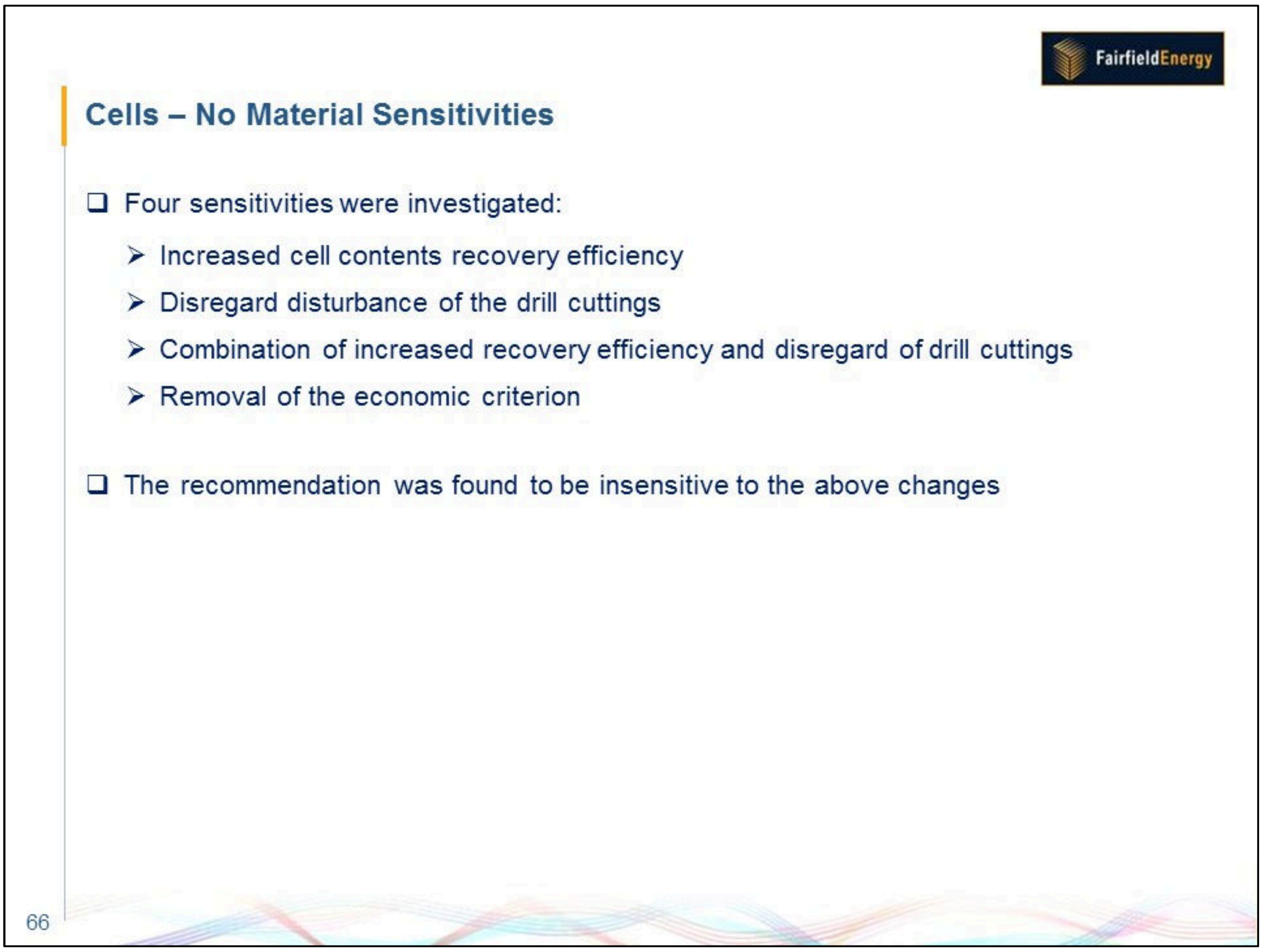
The assessment of the societal criterion considered the societal benefit of creating jobs offset against the negative effect of potentially having to handle large volumes of drill cuttings onshore. There was deemed to be a small benefit associated with development of solutions to recover and manage the sediment materials.

There was only one sub-criterion:
All Groups – The three contents removal options would have a positive impact of creating jobs, making the leave in situ option less favourable in comparison.
However the High Oil and Sediment Removal option involves recovery of a large volume of drill cuttings to shore, potentially ending up in landfill.
The evaluation concluded that there was a small benefit associated with proving the new technology concept to recover and manage sediment materials in the High Oil and Sediment and the Mid Oil and Sediment removal options.



The economic criterion has been evaluated based on cost estimates for the options which have an accuracy of -15 to +50%.

There was only one sub-criterion:
Operational & Legacy Costs – It should be note that as some residual contents will be left in situ for all options, the legacy costs were not considered a differentiator.
The leave in situ option was found to be preferred as it has no execution costs to implement.



Following the CA workshops sensitivity checks were carried out.

This further analysis showed that even if there was a larger quantity of materials to recover from the cells and if there was no requirement to manage the drill cuttings to allow access into the cells, the recovery options are still not preferred on balance.

Similarly considering the options without taking into account the costs associated with the intervention and recovery activities from the cells, showed that the evaluation is insensitive to the economics criteria and that the most preferred option is still to leave the contents in situ.

FairfieldEnergy

Emerging Recommendation for Cells

Option 4
Leave Remaining Contents In Situ

An Environmental Appraisal is in progress and builds upon the study work performed for the Cell Contents Technical Report

Total Inventory	%	Volume (m^3)
Residual Attic Oil	0.42	988
Trapped Oil	0.19	449
Diffused Oil	0.05	128
Total Mobile Oil	**0.66**	**1,565**
Sand / Clay	0.15	363
Scale	0.07	159
Hydrocarbon	0.15	363
Water	0.15	363
Total Sediment	**0.53**	**1,248**
Wall Deposits	**0.19**	**462**
Water Phase	**98.62**	**233,631**

Study findings:

- Contents released over time period 20 to 1000 plus years
- Mechanisms – pipework failure, transition piece failure and concrete spalling
- Instantaneous release ~60m^3 oil (equiv. to 4 cells) is unlikely to reach the shoreline
- Gradual release & bioaccumulation in the food chain would not result in a chronic dose to humans

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The emerging recommendation from the CA for the cell contents is to leave the remaining inventory in situ.
An environmental appraisal is being performed that will detail the fate of the contents and the impact to the environment upon eventual release or exposure.
The study work performed during development of the Cell Contents Technical Report and CA evaluation will be used to inform this impact assessment. The findings of which are:

- The future cell contents will be released as series of events starting in the nearer term time frame of 20-30 years when pipework penetrations degrade and allow oil to be released into the leg cavity, through to several centuries to millennia into the future for the concrete to spall.
- The largest instantaneous release scenario is ~60m^3 of oil (equiv. to 4 cells), due to impact from a falling leg transition piece. This inventory would be unlikely to reach the shoreline, at worst the very North-East coast of Shetland could be affected with a very small volume of oil depositing on the shoreline. International Tanker Owners Pollution Federation (ITOPF) scale for shoreline oiling classes this as “less than light”.

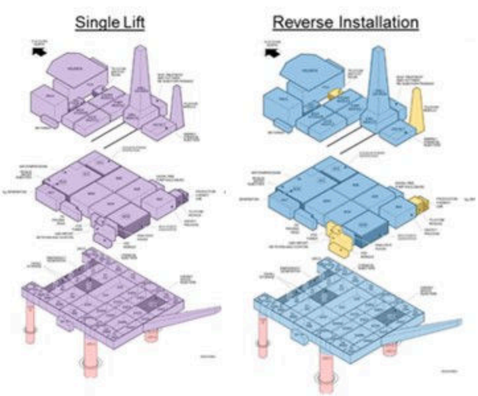
•In the case of a more gradual release over time none of the components within the cells is capable of concentrating into the food chain in sufficient quantity to deliver an acute or chronic dose to humans.

Other Decommissioning Elements

Peter Lee

Update on Dunlin Alpha Topsides Removal

- Invitation to Tender (ITT) for Topsides Removal scope issued Oct 2017
- A number of bids received and currently under technical & commercial evaluation
- Piece Small and Hybrid removal methodologies have now been discounted
- Contract structured around Engineering, Preparation, Removal & Disposal (EPRD)
- Further details would be commercially sensitive - award is anticipated later in 2018



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Dunlin Alpha Drill Cuttings

- Water Based, Oil Emulsion and Low Toxicity Oil Based Muds all used & discharged
- Cuttings have been surveyed, sampled, characterised and assessed against thresholds
- Preferred management option is to leave cuttings to naturally degrade over time

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Update on Subsea Infrastructure Decommissioning

- Three Decommissioning Programmes formally approved in Dec 2017
  - Merlin Pipelines and Structures
  - Osprey Pipelines and Structures
  - Dunlin Fuel Gas Import (DFGI) and Dunlin Power Import (DPI)
- Subsea Infrastructure Decommissioning (SID) contract awarded to Bibby Offshore
- Consortium includes Port of Cromarty Firth, ASCO and John Lawrie Group
- Contract structured around Engineering, Preparation, Removal & Disposal (EPRD)
- Quarterly progress reporting to BEIS & OGA has commenced
- First in-field activity expected to commence in July 2018

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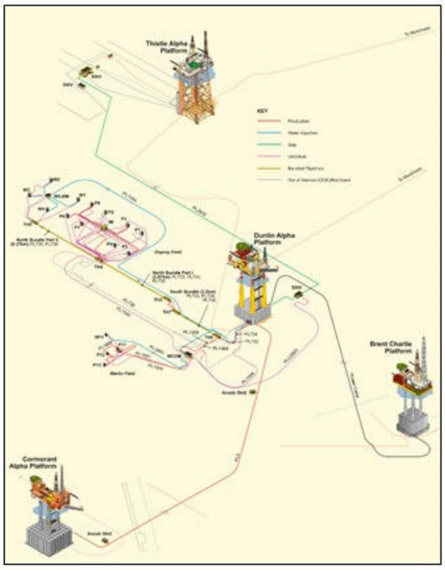
Schedule for PL5 Export Pipeline



Planning	
Screening Completed	Jan 2018
Comparative Assessment (CA) Studies	Ongoing
CA Evaluation Workshop	Oct 2018
Emerging Recommendation Report	Dec 2018
Environmental Appraisal	Dec 2018
Approvals	
Consultation Draft DP Submission	Apr 2019
Public Consultation	May 2019
Decommissioning Programme Approval	Oct 2019
Execution	
Pipeline Conditioning & Flushing	Jul 2019
Physical Disconnection	Aug 2019
Decommissioning Scope Commences	Oct 2019

We ask that stakeholders let us know of their interest in the development of these proposals

FairfieldEnergy

Next Steps and Close

John Wiseman

Dunlin Alpha Decommissioning Workshop – Studies List

3rd May 2018
Aberdeen Exhibition and Conference Centre

List of studies available for inspection at the workshop
Note: some study numbers were allocated but unused

Study 1	Leg Internal Workscope
Study 3	Seabird Colonisation Study
Study 4	Transition Piece Study
Study 4a	Longevity Study
Study 5	Aids for Navigation Study
Study 6	Concrete Cutting & Removal Study
Study 8	Leg Failure Study
Study 9	Marine Growth Study
Study 10	Marine Impact of Full Removal Study
Study 12	Cell Top Debris Study
Study 14	Safety Summary
Study 16	Corrosion Protection
Study 17	Cell Contents Impact Assessment
Study 18	Cell Contents Technical Report
Study 19	Drill Cuttings Technical Report
Study 20	Drill Cuttings Survey
Study 21	Shipping and Fishing Risk Assessment
Study 21a	Addendum to Shipping Risk Assessment – Sensitivity Analysis
Study 23	Transition Coating Study
Study 24	Leg Cutting (Deep) Study
Study 25	Leg Cutting (Shallow and Air) Study
Study 26	Air Gap Analysis
Study 27	Technical Risk Assessment
Study 28	Energy and Emissions Assessment
Study 29	Full Removal Vessel Collision Risk Assessment
Study 30	CA Emerging Recommendation Report

Comparative Assessment Briefing Document

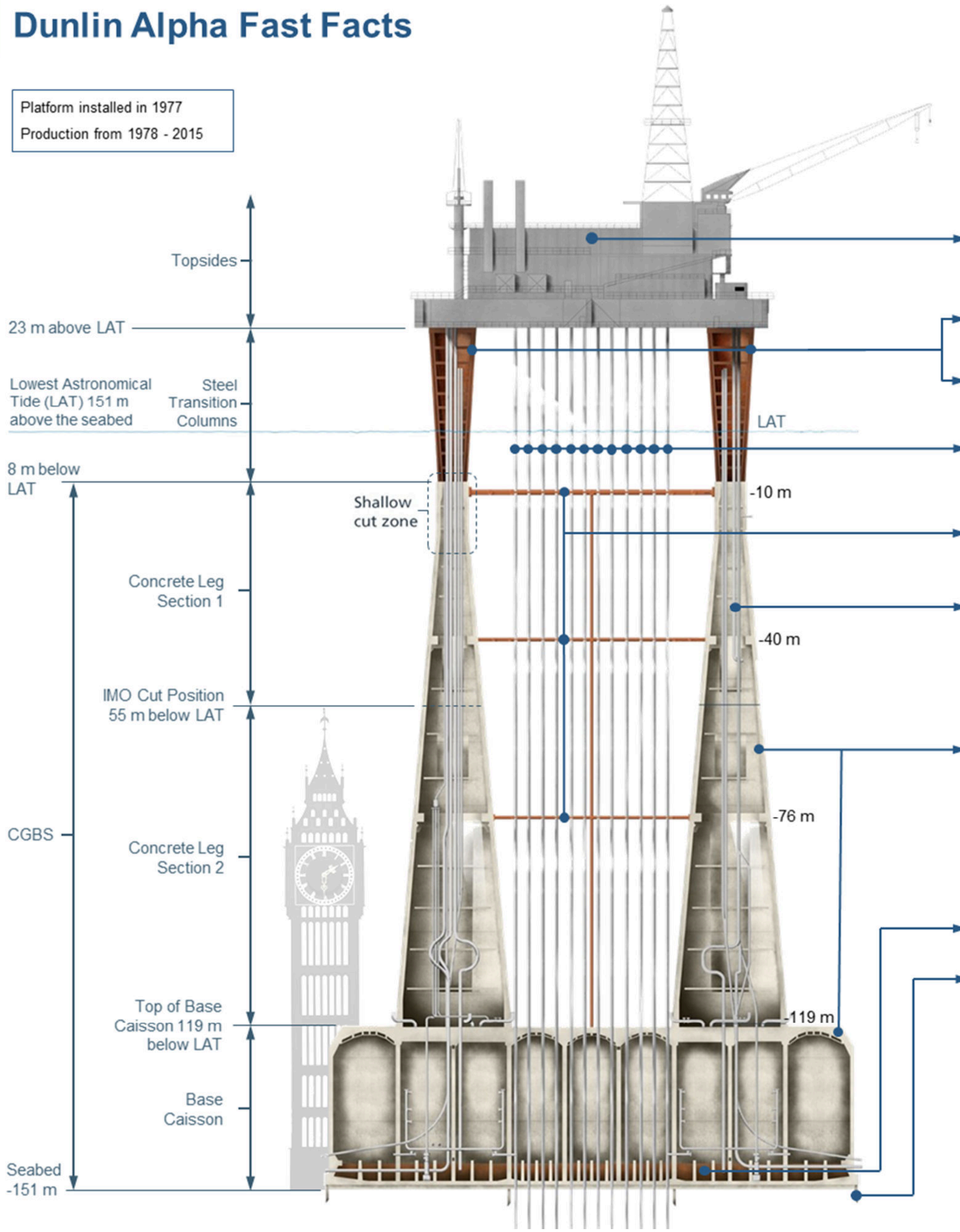
Appendix 5: Briefing Sheets

The briefing sheets, *Dunlin Alpha Fast Facts* and *Dunlin Alpha Cell Contents Fast Facts,* shown in this section, provided participants at the workshop with ready summary of key information about the concrete gravity base structure and cell contents respectively and the range of options assessed for them through the comparative assessment.

Please note that the *Dunlin Alpha Cell Contents Fast Facts* document shown is as at 3 May 2018, and is subject to modification.

Dunlin Alpha Fast Facts

Platform installed in 1977
Production from 1978 - 2015

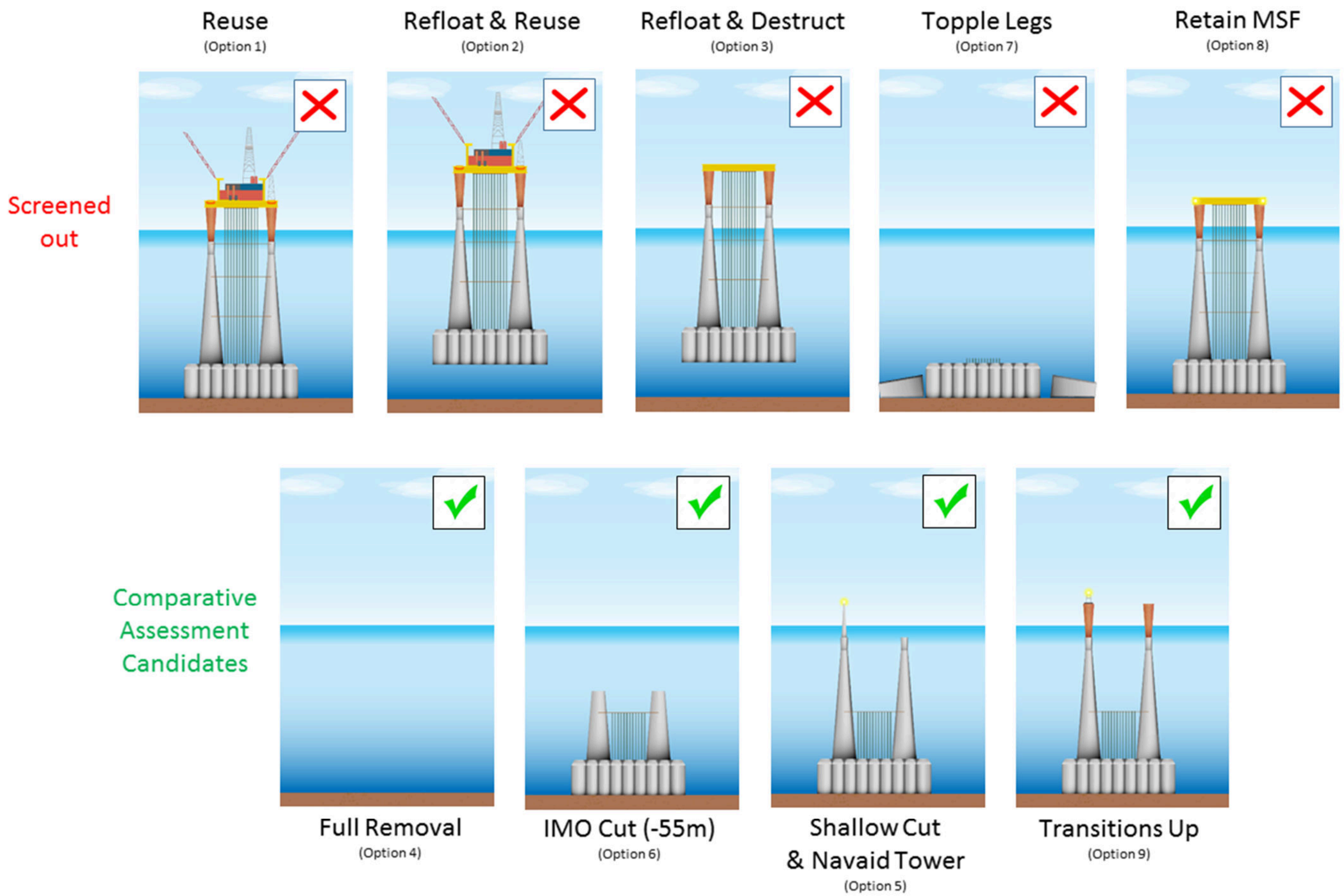


Infrastructure	Approximate Dimensions / Weight	Weight Excludes
Topsides (dry)	19,255 te 63.7 m x 82.3 m Incl. 28 te of NORM 250 te of hazardous materials **Total ≈ 19,535 te**	Operational Weights e.g. Process Fluids Laydown
Steel Transition Columns A & B	2 x 295 te 5.4 m in diameter (cylindrical) and 31 m tall **Total ≈ 590 te**	Leg Internals Marine Growth
Steel Transition Columns C & D	2 x 500 te 5.4 m to 8.9 m in diameter (conical) and 31 m tall **Total ≈ 1,000 te**	Leg Internals Marine Growth
Conductors	45 x 185 m (long) x 30" conductors from EL(+)31 m (LAT) to EL(-)154 m (LAT) (3 m below seabed) **Total ≈ 3,840 te**	Inner completions Marine Growth Clamps / Braces
Conductor Guide Frames and Vertical Supports	1 at EL(-)10 m (LAT) 1 at EL(-)40 m (LAT) 1 at EL(-)76 m (LAT) **Total ≈ 540 te**	Marine Growth Cathodic Protection Skid Material loss (corrosion)
Leg Internals (e.g. pipework, stairs)	Within 4 steel transition columns and CGBS legs from EL(+)23 m (LAT) to EL(-)119 m (LAT) **Total ≈ 1,250 te**	-
CGBS Primary Structure (reinforced concrete)	Concrete leg section 1: 4 x 1,895 te 13 m to 6.7 m in diameter (conical) and 47 m tall Concrete leg section 2: 4 x 6,730 te 22.65 m to 13 m in diameter (conical) and 64 m tall 1 x concrete leg (excl. internals) weighs 8,625 te Base Caisson: 202,000 te 104 m x 104 m x 32 m **Total ≈ 236,500 te**	Transition Columns Marine Growth Leg Internals Base Caisson Internals Cell Contents Ballast
Drill Cuttings	Base caisson roof: **10,200 m³** over 5,100 m² Sea floor: **9,355 m³** over 4,084 m²	-
Iron Ore Ballast and Concrete Cover Layer	Approximately 104 m x 104 m x 3 m deep **Total ≈ 96,800 te**	-
Seabed Skirts	8 x 104 m x 4 m **Total ≈ 1,450 te**	-
Total Weight of CGBS (including contingency)	**Total ≈ 336,000 te**	Topsides Transition pieces Conductors Conductor Guide Frames (wet) Marine Growth (1,400 te) Debris Drill Cuttings Cell Contents Under Caisson Grout
Under Caisson Grout	**Total ≈ 500 te**	-

Rev: May 18

Dunlin Alpha Fast Facts

Dunlin Alpha Comparative Assessment Options



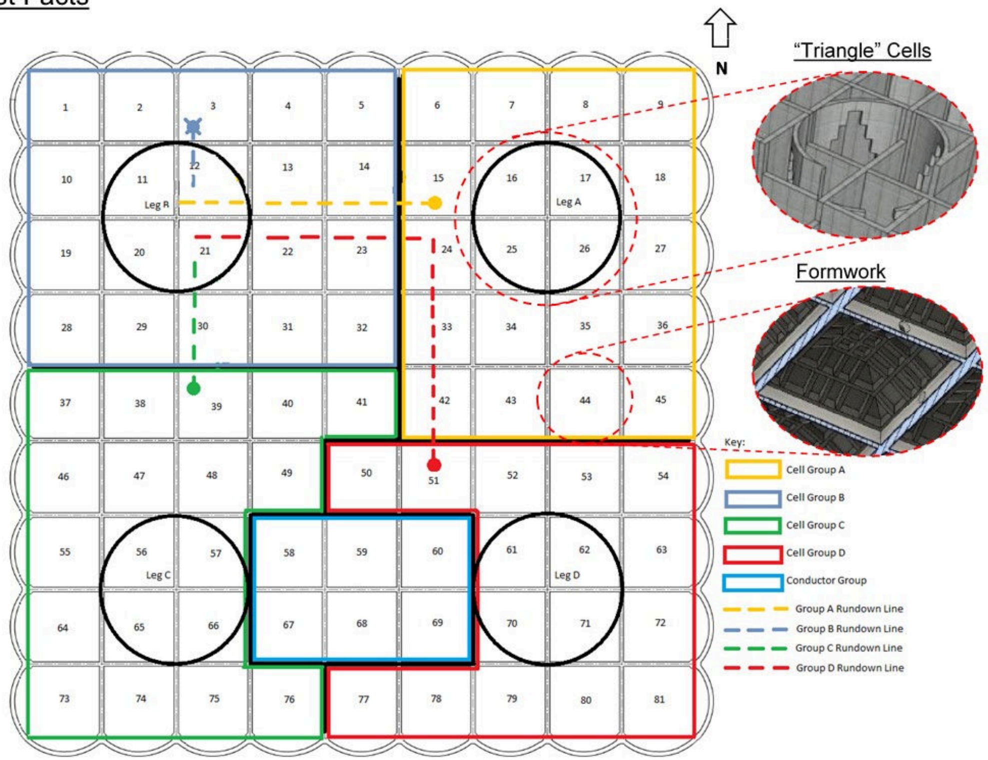
Dunlin Alpha Cell Contents Fast Facts

Storage Cell Overview

This fact sheet provides an overview of the Dunlin Alpha cell contents characterisation work to define the residual inventory within the Concrete Gravity Base Structure (CGBS).

Production commenced in 1978, with the cells operating on a continual basis through until 1995, where thereafter use was limited to occasional periods mainly during start-up. In 2004 the decision was made to no longer use the storage cells and planning commenced to take them out of service permanently. Over this production history the throughput totalled nearly 139 million m^3 of oil and produced water combined.

In 2007, Shell executed a project to recover the mobile oil from within the cells using Carbon Dioxide (CO_2) gas to displace the oil.

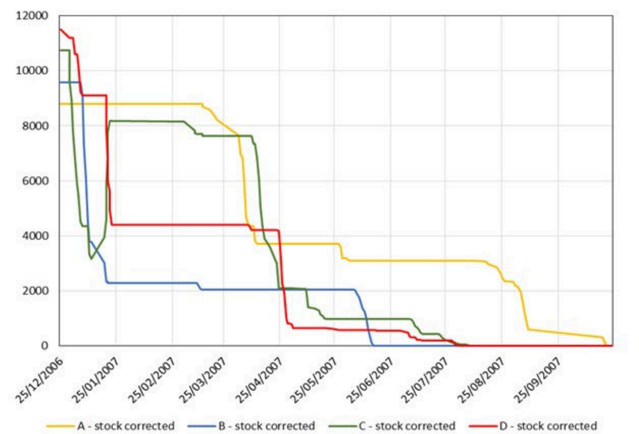


Cell Contents Inventory Summary

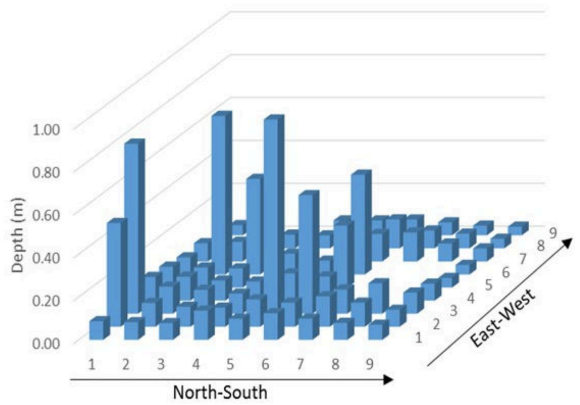
Total Inventory	Volume (m^3)	%
Residual Attic Oil	988	0.42
Trapped Oil	449	0.19
Diffused Oil	128	0.05
Total Mobile Oil	**1,565**	**0.66**
Sand / Clay	363	0.15
Scale	159	0.07
Hydrocarbon	363	0.15
Water	363	0.15
Total Sediment	**1,248**	**0.53**
Wall Residue	**462**	**0.19**
Water Phase	**233,631**	**98.62**

Variation from Individual Cell to Cell	Volume (m^3)	
	Min	Max
Mobile Oil	14.5	59.7
Sediment	5.7	101
Wall Residue	2.3	11.4
Water Phase	2627	3479

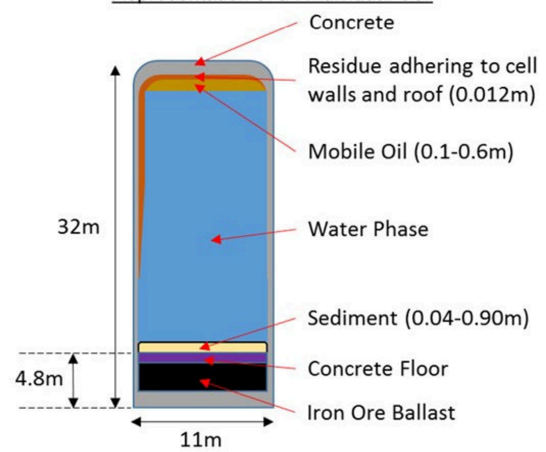
2007 Attic Oil Recovery Project (AORP) – Cell Stock Levels (m^3)

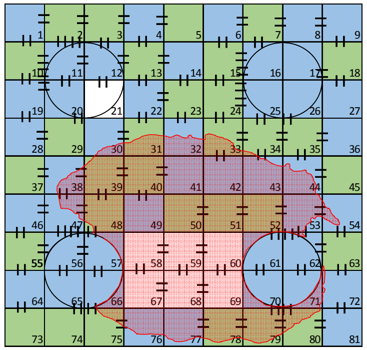
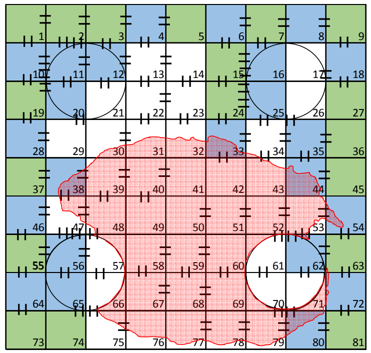
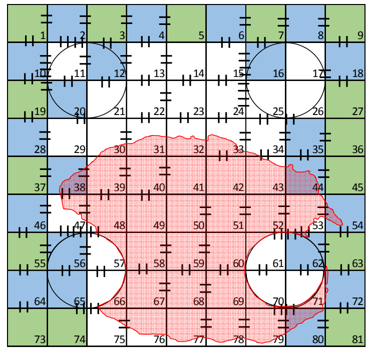
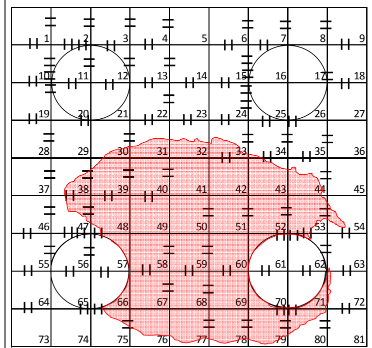


Sediment Distribution



Representation of an Individual Cell



Cell Contents Management Option	Option 1 - High Oil and Sediment Recovery (R7 Hybrid)	Option 2 - Mid Oil and Sediment Recovery (R12 Hybrid)	Option 3 - Mid Oil Recovery (R12)	Option 4 - Leave In Situ
Number of cell penetrations and directly accessed cells (XX small + X larger = XX total)	23 small + 8 larger = 31 total	14 small + 4 larger = 18 total	15 small + 0 larger = 15 total	0 small + 0 larger =0 total
No of cells indirectly accessed	43	23	21	0
No of cells mobile oil to be recovered from	74	41	36	0
No of cells sediment to be recovered from	8	4	0	0
Total volume of materials recovered	Mobile Oil = 599m^3 Sediment = 270m^3	Mobile Oil = 299m^3 Sediment = 147m^3	Mobile Oil = 274m^3 Sediment = 0m^3	Mobile Oil = 0m^3 Sediment = 0m^3
Residual inventory	Mobile Oil = 966m^3 Sediment = 978m^3	Mobile Oil = 1,266m^3 Sediment = 1,101m^3	Mobile Oil = 1,291m^3 Sediment = 1,248m^3	Mobile Oil = 1,565m^3 Sediment = 1,248m^3
Waste generated	Mobile Oil = 599m^3 Sediment Slurry = 2,701m^3	Mobile Oil = 299m^3 Sediment Slurry = 1,470m^3	Mobile Oil = 274m^3 Sediment Slurry = 0m^3	Mobile Oil = 0m^3 Sediment Slurry = 0m^3
Loss of containment (operational)	Mobile Oil = 15m^3 Sediment = 0.2m^3	Mobile Oil = 15m^3 Sediment = 0.2m^3	Mobile Oil = 15m^3 Sediment = 0m^3	Mobile Oil = 0m^3 Sediment = 0m^3
Loss of containment (legacy)	Mobile Oil = 31m^3 Water = 12,821m^3	Mobile Oil = 31m^3 Water = 12,821m^3	Mobile Oil = 31m^3 Water = 12,821m^3	Mobile Oil = 62m^3 Water = 12,789m^3
Extent of drill cuttings disturbance	Full removal	Minimal removal	Minimal removal	No removal
Area of drill cuttings disturbed	6,431m^3	2,057m^3	1,815m^3	0 m^3
Volume of drill cuttings disturbed	10,333m^3	358m^3	303m^3	0m^3
Offshore Execution Duration	445 days	272	224	0
Number of Seasons Campaign	3	2	2	0
Key Directly accessed cell (externally penetrated via cell top) Indirectly accessed cells (accessed via communication port) Not accessed Drill cuttings pile CGB leg Communication port				

Dunlin Alpha Decommissioning Workshop – Jargon Buster

Acronym/Term	Description
AORP	Attic Oil Recovery Programme
AtoN	Aids to Navigation
Bathymetry	The study of seabed topography
BEIS	Department of Business, Energy and Industrial Strategy
BTEX	Benzene, Toluene, Ethylbenzene, Xyline
CA	Comparative Assessment
Cells	The storage compartments on Dunlin Alpha used for the production fluids and conductor cooling, located at the bottom of the CGBS
CGB	Concrete Gravity Base
CGBS	Concrete Gravity Based Structure: on Dunlin Alpha this comprises steel-reinforced concrete forming the storage caisson (75+6 cells) and four legs (up to -8m LAT)
CO2	Carbon dioxide
Conductor Guide Frames	On Dunlin Alpha these comprise 3 x steel support frames located at -10m LAT, -40m LAT and -76m LAT that comprise 48 slots to support the well completion tubulars
Conductors	On Dunlin Alpha, these comprise 46 x outer conductors (30” diameter) housing the inner completions and production tubulars
COP	Cessation of Production
CP	Cathodic Protection
Debris	Accidental dropped objects from the topsides' 40 year operational life (largely scaffold)
DECC	Department of Energy and Climate Change (now replaced by BEIS)
DFGI	Dunlin Fuel Gas Import
DP	Decommissioning Programme
DPI	Dunlin Power Import
Drill cuttings	Product from drilling; at Dunlin Alpha they are located on the caisson roof and seabed on the southern end of the caisson (Cell tops = 10,200m3 over 5,100m2, Seabed = 9,355m3 over 4,084m2)
DTM	Digital Terrain Model
Dunlin Cluster	*see Greater Dunlin Area*
Dynamic Model	Modelling typically involves the use of a computer program and mathematical/scientific correlations (or equations) to model or predict the behaviour of a system in real time
EIA	Environmental Impact Assessment
EL	Elevation
EMT	Environmental Management Team (at BEIS)
EPRD	Engineering, Preparation, Removal and Disposal (used in connection with topsides decommissioning)
FEL	Fairfield Energy Limited
Greater Dunlin Area	Collective term for Dunlin Alpha including the CGBS, Osprey and Merlin tied back fields and facilities, and infrastructure

Acronym/Term	Description
HLV	Heavy Lift Vessel
HSE	Health & Safety Executive
HSE & AI	Health, Safety and Environment & Asset Integrity
HSSE	Health, Safety, Security and Environment
HVAC	Heating, Ventilation and Air Conditioning
IMO	International Maritime Organisation
IOEM	Invert Oil Emulsion Mud
JNCC	Joint Nature Conservation Committee
LAT	Lowest Astronomical Tide
Leg internals	Structural steel and equipment in the Dunlin Alpha transitions and CGBS legs from -119m LAT to +23m LAT
LSA	Low Specific Activity Scale - see NORM
LTOBM	Low Toxicity Oil Based Mud
Macrofaunal Analysis	Analysis of larger organisms in benthic sediments generally regarded as greater than 0.5mm in size
MBES	Multi-Beam Echo Sounder
MODU	Mobile Offshore Drilling Unit
MSF	Module Support Frame
NORM	Naturally Occurring Radioactive Material exists naturally in the geological environment. In the oil and gas industry, salts from the reservoir dissolve in the formation water (and injected seawater if this is used) and can precipitate out as LSA-containing scale deposits in the wells, pipelines and processing equipment
ODU	Offshore Decommissioning Unit (at BEIS)
OGA	Oil and Gas Authority
OGUK	Oil and Gas UK
OLF	Norwegian Oil and Gas Association (previously Norwegian Oil Industry Association)
OPRED	Offshore Petroleum Regulator for Environment & Decommissioning
Options 1-9	The different structural options for the Dunlin Alpha installation which have been considered; four have been identified as feasible
OSPAR Convention	The Oslo/Paris Convention for the Protection of the Marine Environment of the North-East Atlantic
OSPAR Decision 98/3	The 1998 OSPAR Decision on the disposal of disused offshore installations, to which the UK is a Contracting Party
P&A	Well Plugging and Abandonment: setting of cement plugs to isolate the reservoir. For Dunlin Alpha this includes removing the completion and conductors down to -76m LAT
PAH	Poly-aromatic Hydrocarbon
PL5	The export pipeline from the Dunlin Alpha installation
POB	Personnel On Board
Rebar	Short for 'Reinforcing Bar', rebar comprises steel bars or a mesh of steel wires used as a tensioning device in reinforced concrete and masonry structures to strengthen and hold the concrete in tension. It is often patterned to form a better bond with the concrete.

Acronym/Term	Description
Ring Beam	A stiffened structural section with the CGB leg to take additional loads, e.g. the conductor guide frame and transition sections
Risers	The vertical portion of a subsea pipeline (including the bottom bend) arriving on or departing from a platform
ROV	Remotely Operated Vessel
SEPA	Scottish Environmental Protection Agency
SFF	Scottish Fishermen's Federation
SME	Subject Matter Expert
Synthetic Fluids	Fluids manufactured from starting products of known composition and purity
t / te / mT	metric tonnes
THC	Total Hydrocarbon Content
Topsides	Platform that sits on the 4 steel transitions of Dunlin Alpha comprising of the Module Support Frame (MSF), Module deck, Drilling deck and accommodation
Transitions	Steel columns which on Dunlin rise from -8m LAT to +23m LAT and act as the interface between the topsides and CGBS
Tubulars	Steel pipe
Umbilicals	A single or multiple cored line (e.g. cable or hose) used to deliver services between assets (e.g. power, hydraulics, chemicals)
Vibrocorer	Sampling device with an electric motor that creates vibrations which drives the core barrel into the soil
WBM	Water Based Mud

Appendix 7: Information Posters

This appendix contains a series of posters that were displayed at the workshop to illustrate in more detail the various structural and decommissioning aspects of Dunlin Alpha. These cover the following topics:

- Concrete Gravity Base Structure (CGBS)
- Cell Contents

Concrete Gravity Base Structure Information Posters

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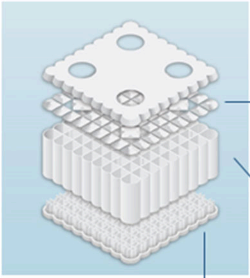
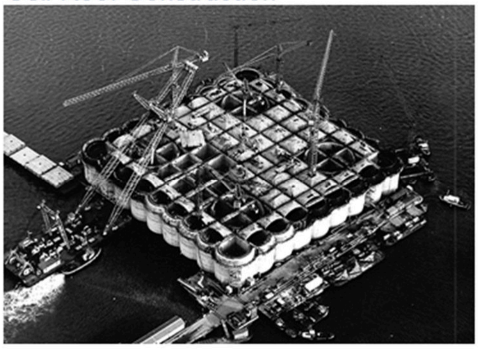
Construction Phase - Cells

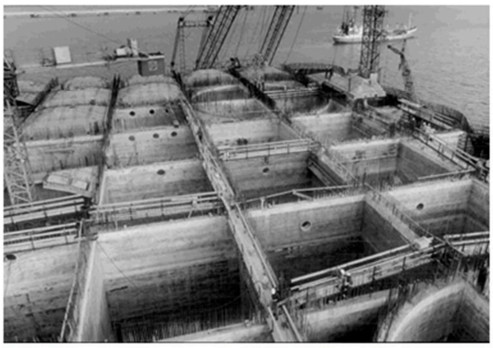


Cell Roof Construction



Cell Internal Ribbed Walls

Cell Walls



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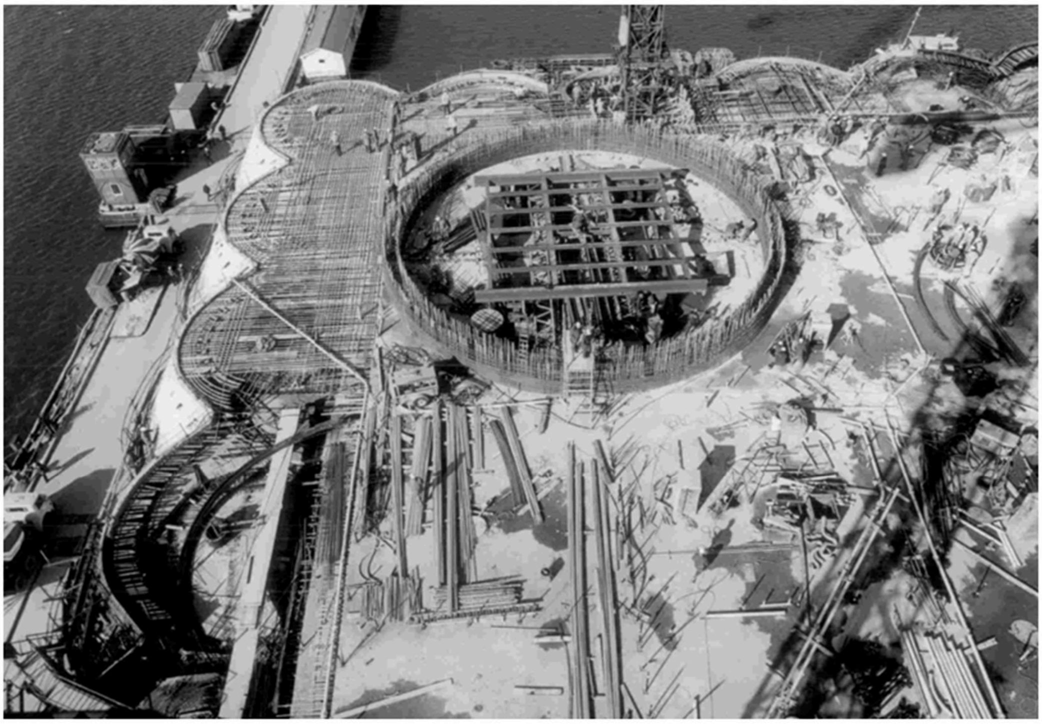
Construction Phase – Cell Roof and Base of Leg



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Construction Phase - Legs and Steel Transition

3

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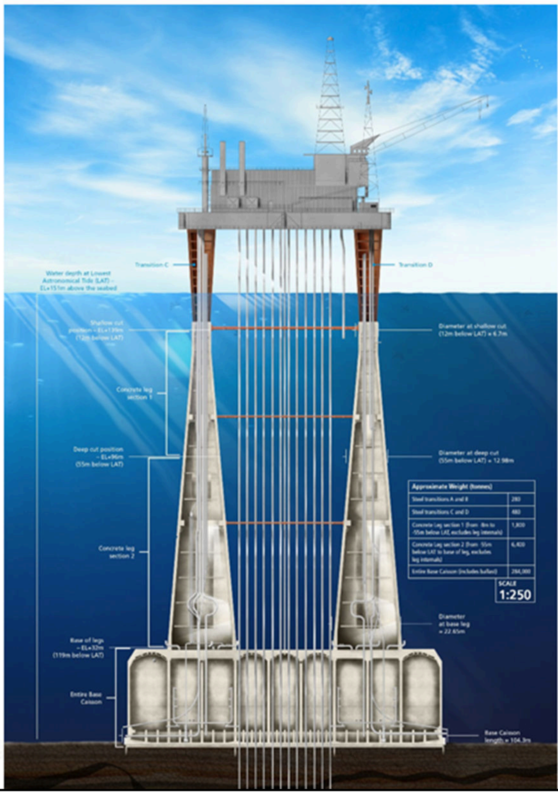
Construction Phase – Legs and Cell Roof

4

Structural Overview



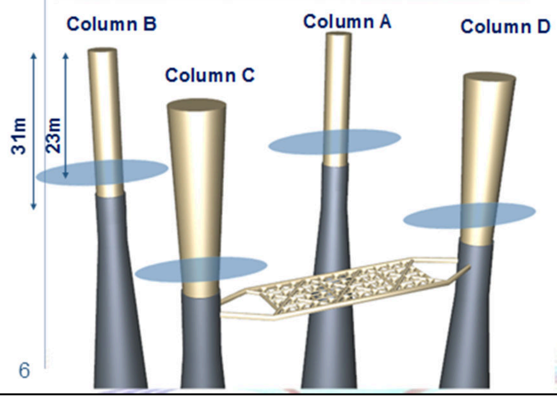
- Steel Transitions
- Reinforced Concrete Legs
  - Leg Internals
  - Ring Beam
- 45 x conductors

  Conductor Guide Frames at 3 Levels
- Reinforced Concrete Cells

Item	Weight (te)
Cells (9 x 9 = 81)	202,000
Iron Ore Ballast & Grout Layer	96,800
Seabed Skirts	1450
Under Caisson Grout	500

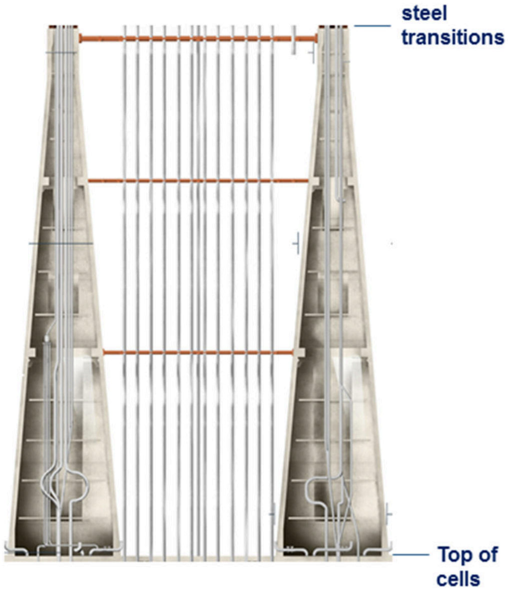
- Water Depth = 151m

Steel Transitions – Unique Challenges



- Constraints during construction
  - Extra long steel transitions
  - Span below water, unique in North Sea
- Corrosion
  - Managed by internal coatings and CP
  - Current condition, minimal corrosion wall thickness loss since installation
- Bolted to top of concrete legs
  - Bolts grouted, cannot easily be inspected so condition unknown
- Steel transitions spanning below water add unique level of complexity for the decommissioning of the Dunlin Alpha CGBS

CGBS Legs - Key Features & Considerations

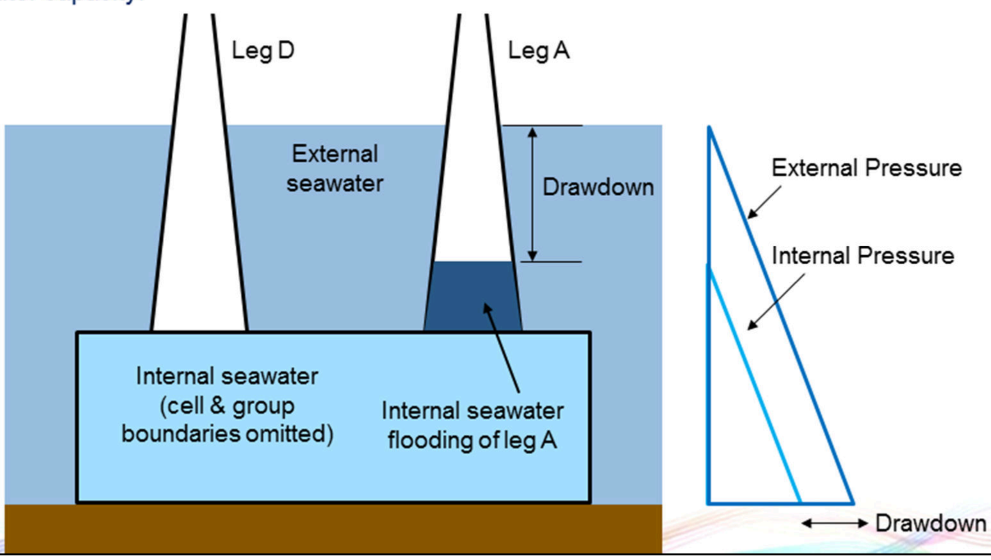


- 4 legs, 111m in length
- Ringbeam at 8m below LAT
  - Connection for steel transitions
  - Anchorage for the leg prestressing tendons
  - Integrity of legs dependent on retention of ringbeam
- Leg Internals
  - Legs house materials / equipment known as leg internals (piping systems, access, etc.)
- Drawdown System
  - Water levels inside legs lower than outside, provides compression in the concrete

7

CGBS Drawdown System

- Leg A is partially filled with water up to EL +70m level, while legs B, C and D are maintained dry
- This induces compression in the concrete and maintains the pressure in the cells below external pressure, and this pressure differential is referred to as the drawdown system.
- The drawdown system acts with the prestressing system to give the concrete legs and cells greater capacity.



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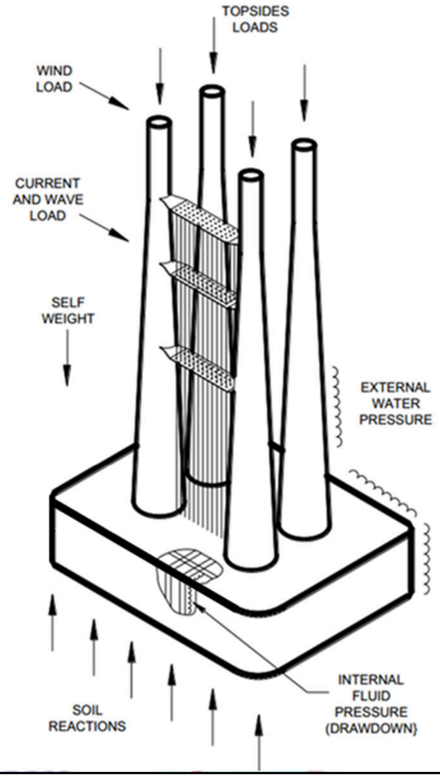
Loading on the Platform Substructure

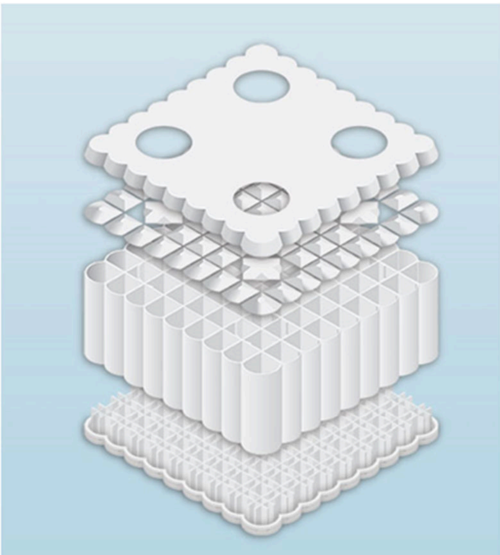


Changes to substructure loading following topsides removal

- Environmental loading will reduce significantly due to removal of conductors to -74m
- Vertical loading will reduce significantly due to topsides removal
- Hydrostatic compression is lost when legs are flooded.
- Composite portal frame action is lost with MSF and topsides removed – legs behave independently instead of together

9

CGBS Cells - Key Features & Considerations



- Each cell
  - Roof, walls, base slab

Item	Dimensions (length x breadth x height)
One cell	11 x 11 x 32m
81 cells	104 x 104 x 32m

- Total cell group ≈ 300,750 te (concrete, steel reinforcement & solid iron ore ballast)

Item	Weight (te)
Cells (9 x 9 = 81)	202,000
Ballast	96,800
Steel Skirts	1450
Grout	500

- Grout and soil adhering to the base slab increases weight further

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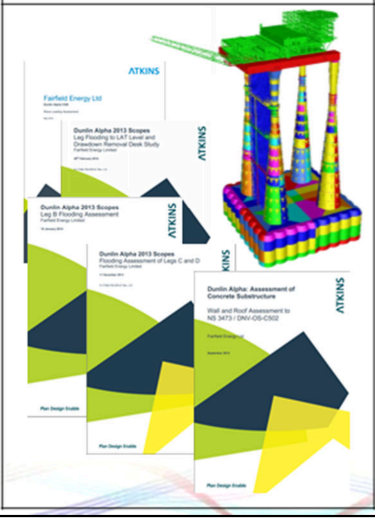
Structural Integrity & Decommissioning Study Work

- Decommissioning team has 40 years of Dunlin Alpha asset knowledge spanning from construction, operation (30 years with Shell, 10 years with Fairfield), late life and decommissioning.
- This includes extensive technical studies for the structural integrity management of the operational asset and supporting with decommissioning over last 10 years.
- The Dunlin Alpha decommissioning technical study work has benefitted from depth of asset knowledge, input from subject matter experts and experience gained from analogous decommissioning projects.

Structural Integrity Study Work	Previous Decommissioning Study Work	Recent Decommissioning Study Work
		

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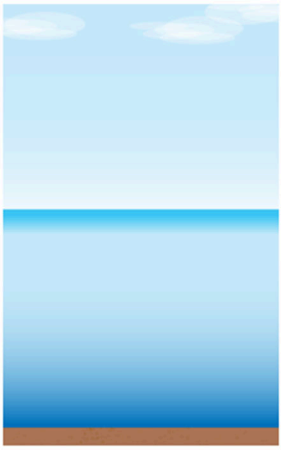
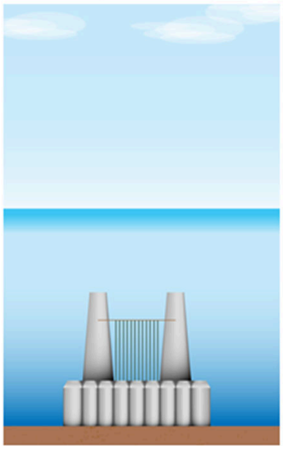
Decommissioning Options for Legs & Cells

Option 4



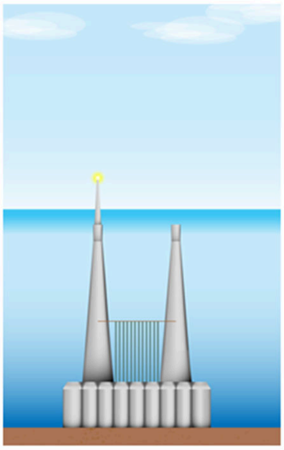
Full Removal

Option 6



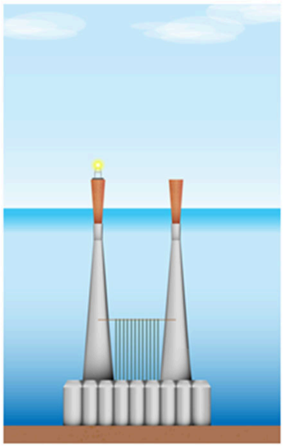
Remove to -55m

Option 5



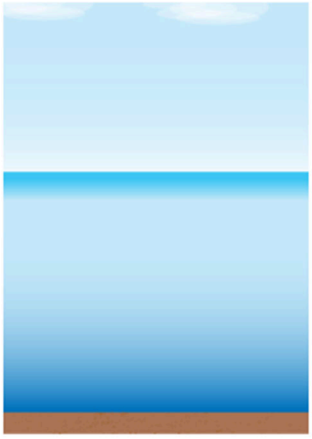
Remove Leg Transitions & Install Navaid Lighthouse

Option 9



Leave in Place & Install Navaid

Technical Challenges for Decommissioning

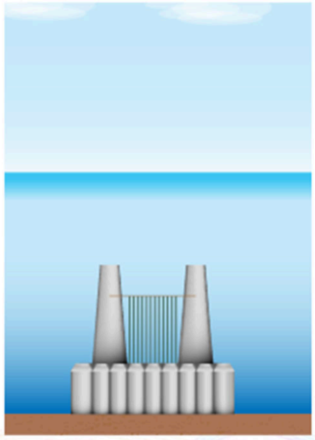


Full Removal (Option 4)

- 3 separate leg cuts (shallow, -55m, -119m) + cell removal
- Scale / complexity of removing approx. 300,000te at 151m depth
- Technology development novel
- Base slab + ballast + grout involves thick vertical cuts
- Suction release required to remove base slab / skirts
- Option 6 considerations also apply

Remove to -55m (Option 6)

- Cutting concrete at this scale subsea has not been done before
- Transition bolt integrity – need for shallow and -55m leg cuts
- Hostile Northern North Sea (cutting & lifting)



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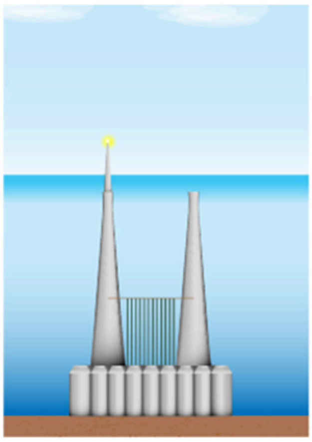
Technical Challenges for Decommissioning

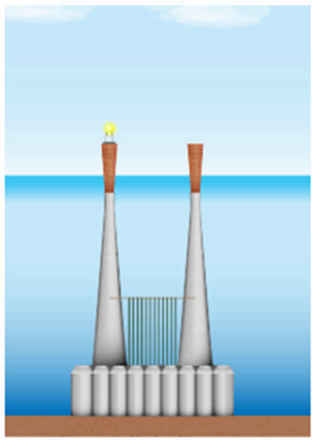


Remove Steel Transitions & Install Lighthouse (Option 5)

- Lighthouse relies on ring beam. Operational issues with shallow cut above ring beam
- Concrete lighthouse – complex installation and subsea connection
- Long term integrity of the legs and cell group (degradation, longevity) - may damage cells

Leave In Place & Install Navaid (Option 9)

- Long term integrity of the steel transitions, legs and cell group (corrosion, degradation, longevity) - may damage cells



14

Cell Contents Information Posters

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Dunlin Alpha – Cell Contents Technical Report

Section	Contents
Preface	Provides document context and purpose as well as details of stakeholder engagement and independent review activities.
Background	Provides an overview of the construction, installation and operational history, including the retirement of the storage cells and project to recover residual oil from the cells.
Cell Inventory Assessment	Details the base case inventory and characterisation of the residual cell contents.
Validation of Cell Inventory	Assesses the basis for the inventory in terms of level of confidence in the data and methodology used. Summarises additional steps taken to validate and increase the level of confidence in the inventory assessment.
Cell Contents Management Options	Provides a detailed summary of the comparative assessment undertaken to select a long term management option for the cell contents.
Environmental Impact	Defines and assesses the impact of a release of the contents, including instantaneous and gradual releases or exposure to the surrounding environment. A review of the residual risk is summarised, including evaluation of additional mitigation options and legacy management strategy.
Proposed Cell Contents Management Strategy	Provides summary of the cell contents evaluation recommendation and further detail on the project activities through to decommissioning, including further validation work.

1

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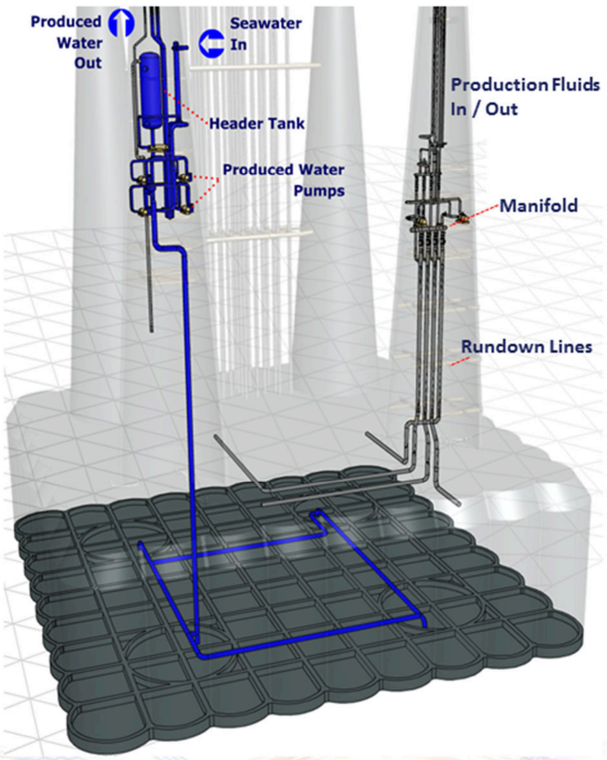
Dunlin Alpha Structure – Cell Contents Key Facts

- Cell storage system:
  - 104 m square and 32 m high
  - 81 Cells
    - 75 for Storage
    - 6 for Conductor Cooling
- Total cell storage internal volume:
  - Approx. 240,000 m^3
- Operational History
  - 1978-1995 Continuous use
  - 1995-2004 Intermittent use
  - 2004-2006 No use
  - 2007 Taken out of use permanently
- Total throughput:
  - More than 54 million m^3 of oil
  - Almost 85 million m^3 of water



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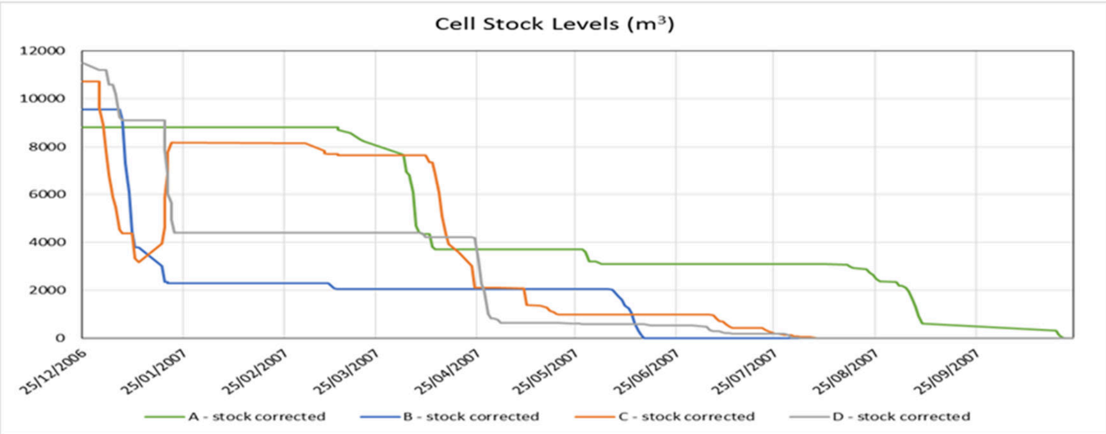
Attic Oil Recovery Project (AORP)

- Carbon Dioxide displacement.
- Offshore execution works lasted approx. 1 year
- Resources utilised:
  - 27,000 tonnes of bulk chemicals
  - 700 road tanker movements
  - 9 round trip supply vessel sailings

Cell Group	Completion Date	Oil Recovery (m^3)
B	27/06/07	9733
D	06/08/07	11081
C	08/08/07	10614
A	02/11/07	8862



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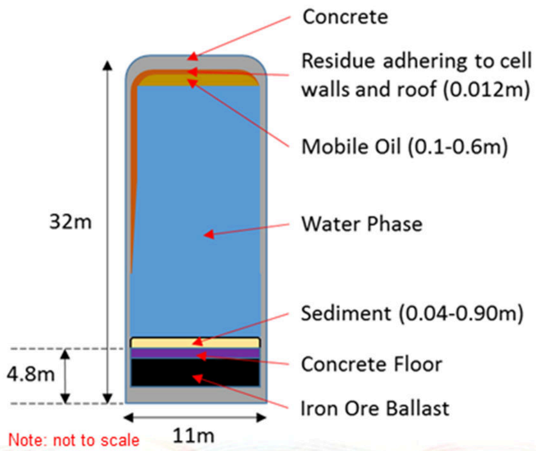
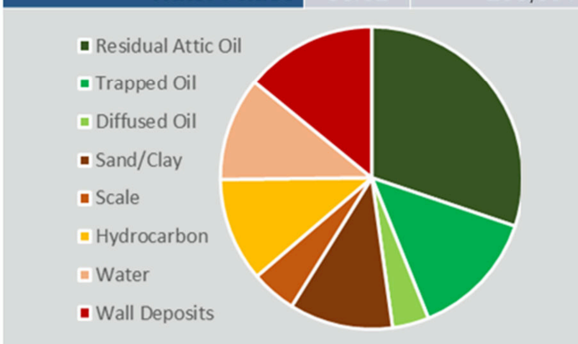
Cell Contents – Inventory

Variation from Individual Cell to Cell	Volume (m^3)	
	Minimum	Maximum
Mobile Oil	14.5	59.7
Sediment	5.7	101
Wall Residue	2.3	11.4
Water Phase	2627	3479

Total Inventory	%	Volume (m^3)
Residual Attic Oil	0.42	988
Trapped Oil	0.19	449
Diffused Oil	0.05	128
Total Mobile Oil	0.66	1,565
Sand / Clay	0.15	363
Scale	0.07	159
Hydrocarbon	0.15	363
Water	0.15	363
Total Sediment	0.53	1,248
Wall Deposits	0.19	462
Water Phase	98.62	233,631





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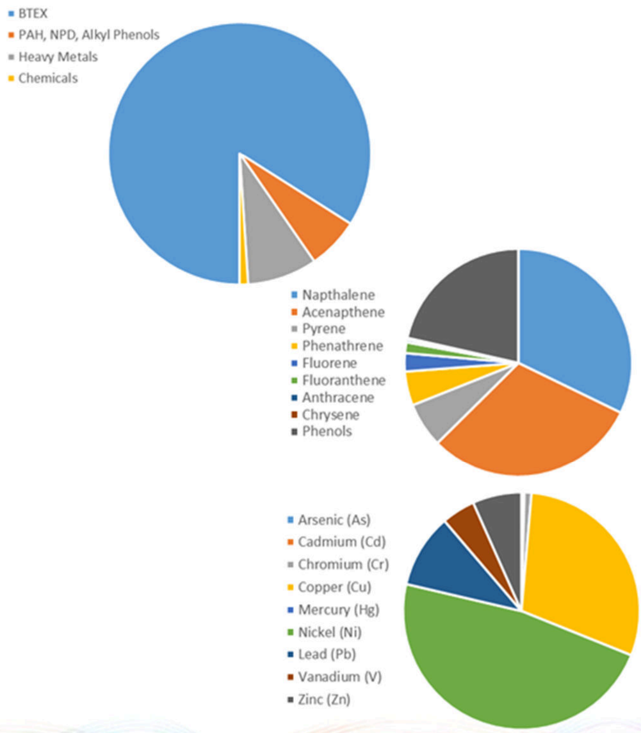
Inventory Basis – Composition of Residual Materials

Phase	Mass (tonnes)	%
Benzene	2.76	8.08
Toluene	7.31	21.39
Ethylbenzene	5.79	16.95
Xylenes (o,p,m)	12.85	37.61
Total BTEX	28.7	84.02
Napthalene	0.70	2.05
Acenapthene	0.66	1.94
Pyrene	0.14	0.41
Phenathrene	0.11	0.31
Fluorene	0.06	0.16
Fluoranthene	0.03	0.10
Anthracene	0.01	0.02
Chrysene	0.00	0.01
Phenols	0.47	1.37
Total PAH, NPD and Alkyl Phenols	2.18	6.37
Arsenic (As)	0.01	0.02
Cadmium (Cd)	0.00	0.01
Chromium (Cr)	0.03	0.08
Copper (Cu)	0.87	2.55
Mercury (Hg)	0.00	0.00
Nickel (Ni)	1.40	4.08
Lead (Pb)	0.30	0.87
Vanadium (V)	0.13	0.39
Zinc (Zn)	0.20	0.57
Total Heavy Metals	2.93	8.59
O_2 Scav, Scale Inh. & Demuls	0.34	0.99
NP/NPE	0.01	0.04
Total Chemicals	0.35	1.03
Total Mass	34.2	100



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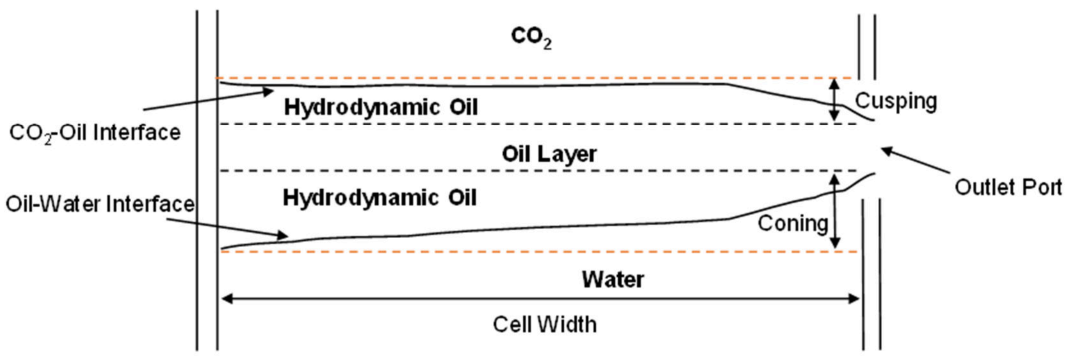
Inventory Basis – Mobile Oil

- Residual oil from AORP, evenly distributed.
- Hydrocarbons which have diffused over time from the sediment layer on the floor or wall deposits.
- Oil trapped in 10 “triangle” cells underneath the legs = 450m^3.

Cell Group	No of Cells	Mobile Oil Volume (m^3)
A	20	377
B	20	390
C	19	421
D	16	377
Total	75	1,565



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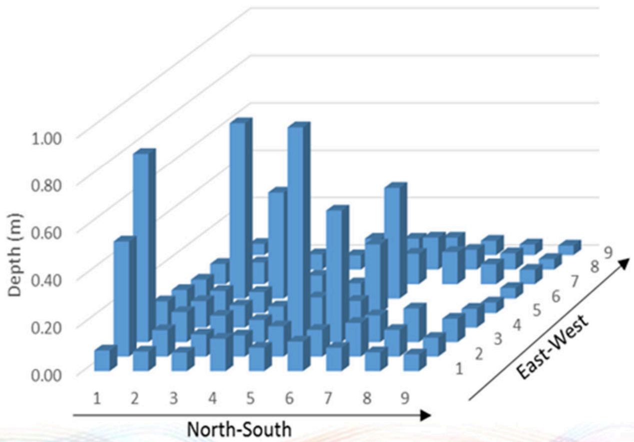
Inventory Basis – Solid and Sediment Materials

- Average sand deposition rate of $7g/m^3$
- Total solids deposition = $363m^3$
  - A:B:C:D Cell Group split = 0.25:0.3:0.3:0.15
- Total scale deposition = $159m^3$
- Uneven distribution within group, based on distance from inlet pipework and communication paths.
- Sediment - even proportions of Sand:HC:Water

Cell Group	No of Cells	Sediment Volume (m^3)
A	20	284.4
B	20	378.2
C	19	378.2
D	16	207.5
Total	75	1248



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Inventory Basis – Material Adhered to Walls and Ceiling

- WAT = 24°C to 32°C
- No asphaltenes
- Thermal modelling, wax deposition = $0.00159mm.day^{-1}$, approx. 12mm over field life
- Wax gel injection during the AORP

Cell Group	No of Cells	Wall Residue Volume (m^3)		
		Hydrocarbon Deposits	AORP Wax	Total
A	20	79	78	157
B	20	79	78	157
C	19	77	0	77
D	16	70	0	70
Total	75	306	156	462

Inventory Basis – Water Phase

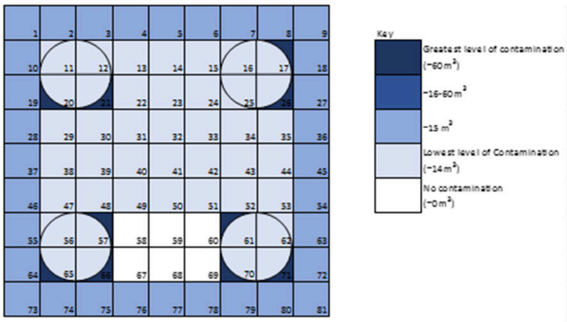
- Cells are completely liquid filled.
- Volume determined based on cell geometry.
- Heavy metal and HC concentration will vary between cells depending on contamination in other phases.

Cell Group	No of Cells	Water Volume (m^3)
A	20	57,765
B	20	57,671
C	19	54,921
D	16	46,800
Conductor	6	16,475
Total	81	233,631

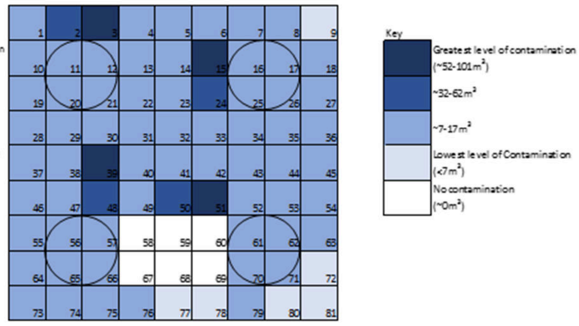
8

Cell Contents – Distribution of Contamination

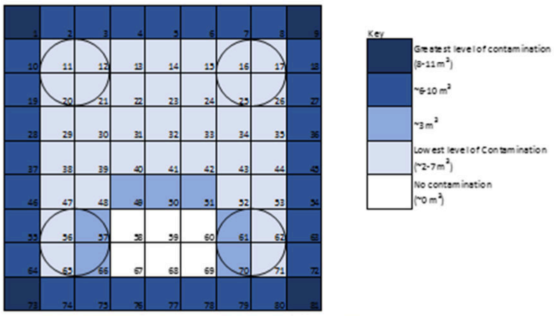
Oil Contamination



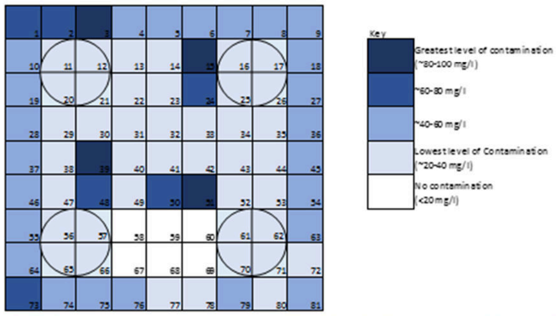
Sediment Contamination



Wall Residue Contamination



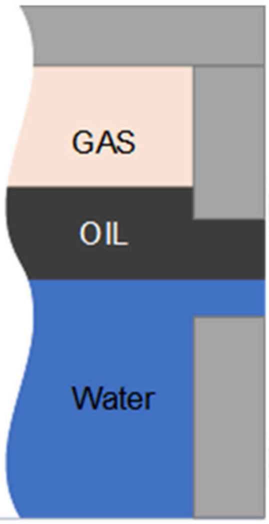
Water Phase Contamination

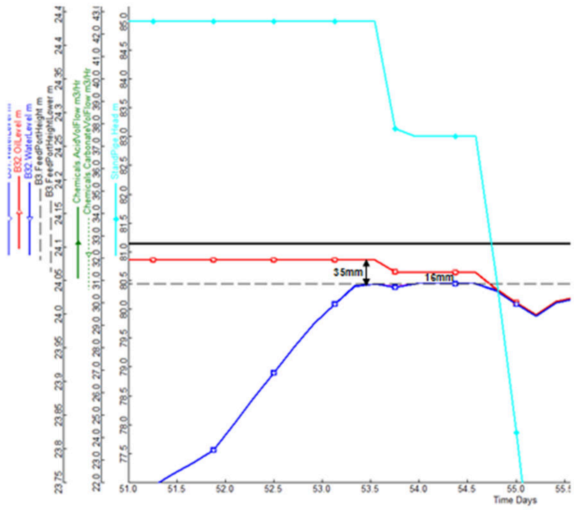


Inventory Validation – Dynamic Modelling

Aspen Custom Modeller, Version 8.8 (34.0.0.109) was used to dynamically model the AORP recovery process in Cell Group B.

➢ This software allows the creation of custom unit operations described through mathematical equations that represent the chemical reaction and flow of oil, water and gas through the cells.





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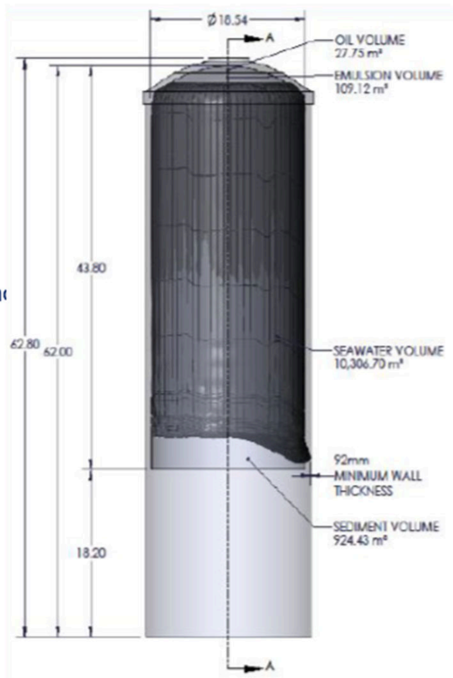
Inventory Validation – Theoretical Evidence

- Analogous Data
  - ➢ Similar structures with storage facilities investigated.
    - Shell – Brent Bravo, Charlie & Delta
    - TAQA – Cormorant Alpha
    - Statoil – Statfjord Alpha, Bravo & Charlie
    - Dong Energy – Siri
    - Conoco Phillips – Maureen Steel Gravity Platform and Articulated Loading Column
    - Conoco Phillips – Ekofisk Tank
    - Shell – Brent Spar
    - BP – Sullom Voe Terminal
- Operational Data
  - ➢ Sampling from topsides separators in 2009 and 2017
  - ➢ Produced Water sampling from historical operations
  - ➢ Export Pipeline Pigging in 2015



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Cell Contents Management Options – Scoping Considerations

- Option considerations include:
  - ➢ Presence of drill cuttings (full removal, minimal/moderate/substantial disturbance)
  - ➢ Direct/indirect cell penetrations – technical feasibility of running hoses to access fluids (oil/water) in neighbouring, leg and triangle cells
  - ➢ Volume of waste created
  - ➢ Duration of operations
  - ➢ Degree of residual hydrocarbon contamination and management option efficiency

How will the residual cell contents be accessed?
× Existing pipework (i.e. vent lines, rundown lines, water ballast, etc)
✓ New penetration in cell top (requires cell top clearance)
× New penetration in cell side wall

How will the residual cell contents be managed?
✓ Removal
× Bioremediation
× Capping
✓ Leave In Situ

Which phases of material will be targeted?
✓ Mobile oil
✓ Sediment
× Wall Residue
× Water Phase

How will any waste created/recovered be managed?
✓ Ship to Shore
× Inject to Well
× Onsite Treatment

Which cells should be targeted?
✓ All of the cells
✓ Selected cells

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Cell Contents Management Options – Execution Method Statement

Each recovery option involves the same execution steps – activity durations are different.

Drill Cutting Clearance

- Mobilise Reel / Hopper Vessel & Grab System and Small CSV.
- Pre-operations survey.
- Partial debris removal (as required).
- Full / partial cuttings removal by grab excavation.
- As-left and seabed sample survey.
- Demobilise.

External Cell Access

- Mobilise CSV / Suction Dredger and Waste Transport Vessel.
- Fitting of Enpro base plate to cell top by CSV.
- Concrete coring of cell top.
- Fitting of isolation valves and cell access lines.
- Pre-operations survey.

Contents Recovery

- Pump recoverable oil.
- Removal of sediment (if applicable).

Post Operations Work

- Removal of base plate.
- Removal of cell access lines.
- Post-operations survey.
- Move to next cell / demobilise.

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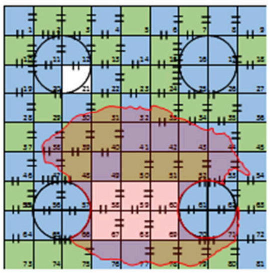
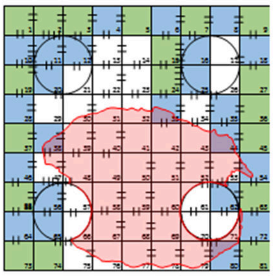
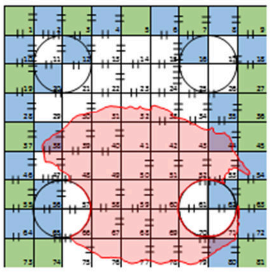
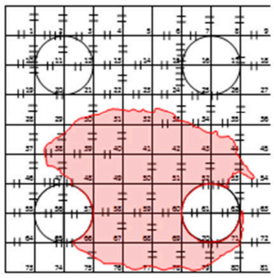
FairfieldEnergy

Options in Cells Comparative Assessment

Option 1	Option 2	Option 3	Option 4
			
High Oil/Sediment	**Mid Oil/Sediment**	**Mid Oil**	**Leave in Situ**
Full Cuttings Removal	Min Cuttings Removal	Min Cuttings Removal	No Cuttings Disturbance
31 Cell Penetrations	18 Cell Penetrations	15 Cell Penetrations	No Cell Penetrations
Mobile Oil from 74 Cells 599m3 Recovered	Mobile Oil from 41 Cells 299m3 Recovered	Mobile Oil from 36 Cells 274m3 Recovered	No Mobile Oil Recovered
Sediment from 8 Cells 270m3 Recovered	Sediment from 4 Cells 147m3 Recovered	No Sediment Recovered	No Sediment Recovered
445 Day Campaign	272 Day Campaign	224 Day Campaign	No Campaign

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Cell Contents Management Options – CA Preparation and Evaluation

Main Criteria	Sub-Criteria	Description	CA Input
Safety	Operational Personnel	Safety risks to offshore personnel relating to the option execution work.	**Quantitative** – PLL based on activity durations.
	Legacy Impact	Residual safety risk to personnel associated with long-term monitoring work.	**Qualitative** – based on requirement for long-term monitoring and durations.
Environment	Operational Marine Impact	Marine environmental impacts associated with offshore operations. Includes both planned impacts (inherent to the option being assessed) and potential unplanned impacts (unplanned releases).	**Quantitative** – m^2 and m^3 based on drill cuttings disturbance. **Qualitative** – comparison of planned/unplanned release supported by rate, duration and environmental impact.
	Energy and Emissions	Amount of fuel consumed to provide energy for the vessel operations and resultant atmospheric emissions.	**Quantitative** – GJ energy and Te CO_2 based activities and durations.
	Legacy Impacts	Potential release of residual contents. Marine impact due to long-tern monitoring work.	**Qualitative** – based on residual inventory, release scenarios and environmental impact.
Technical	Project Technical Risk	Various technical risks which could result in a major project failure.	**Qualitative** – based on concept maturity, availability of technology, track record, consequences of failure, etc.
Societal	All Groups	Societal impact of option.	**Qualitative** – based on impact to fishing industry, employment benefits, benefit of technology development, etc.
Economic	Operational and Legacy Costs	Cost of delivering option as described and any long-tern liabilities such as monitoring.	**Quantitative** - £ based on activities, durations, equipment costs, etc. associated with operations. Legacy costs assessed separately.

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Cell Contents Environmental Impact

- The environmental impact associated with the in situ cell contents was assessed using the following a standard Source-Receptor-Pathway technique.

- In addition modelling has been carried out to understand the impact of an oil release to the surrounding seabed and coastline.

- Structural integrity studies carried out by Atkins have shown that the CGBS acts as a highly effective barrier and will provide containment of the cell contents for centuries.

- Any loss of containment can be classed as either:
  - Small, gradual releases as the structure degrades; or
  - Larger, instantaneous releases due to the cell tops being struck by falling pieces of the structure e.g. transition pieces.

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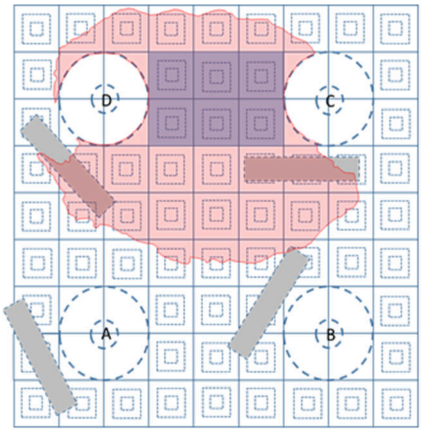
Cell Contents Environmental Impact

Instantaneous Release

- Largest instantaneous release scenario is loss of contents due to the breach of the cell roof structure – most likely caused by falling steel transition pieces.
- The size and likely direction of fall could result in a release from up to 4 cells.
- Unlikely that more than one transition piece would fall at the same time therefore 4 possible instances.
- From the Base Case inventory, the instantaneous release volumes are:
- The mobile oil release was modelled to understand the environmental impact.

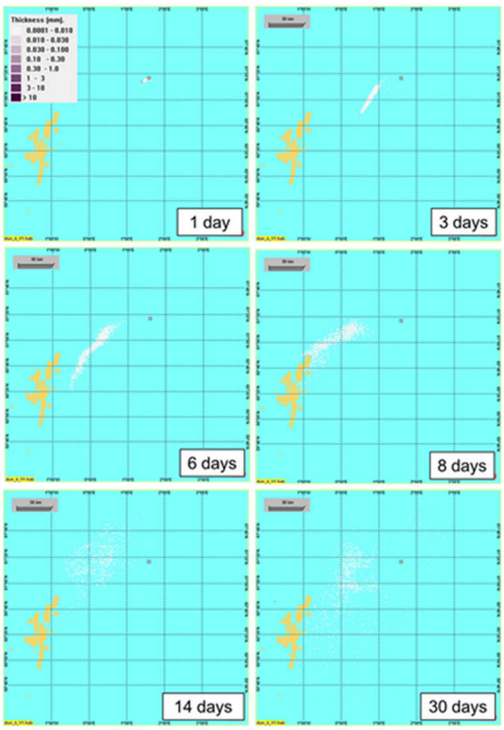


Inventory Phase	Volume (m^3)	Pathway
Mobile Oil	50-100	Release
Water Phase	13,000	Interchange
Wall Residue	40	Exposure
Sediment	190	Exposure

Cell Contents Environmental Impact

Mobile Oil Instantaneous Release

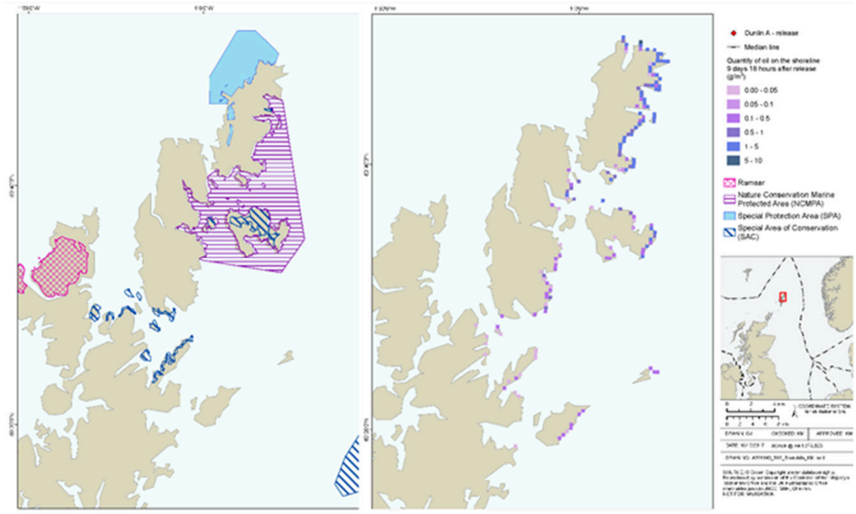
- Potential oil releases of 50 and 100 m^3 were modelled using the Oil Spill Contingency and Response (OSCAR) software developed by Sintef.
- The model mimicked the worst case met ocean conditions to ensure that any oil spill was directed towards the Shetland coast. This is considered to be conservative.
- In both cases, beaching occurred along the east coast of Shetland. First occurrence 6-7 days after spillage but maximum oil concentrations do not exceed to ITOPF light category.
- Based on the relatively lower volumes, any release will be likely to be undetected on the coastline of Shetland and no intervention effort is anticipated to be required.



Cell Contents Environmental Impact

Mobile Oil Instantaneous Release – $50m^3$

- Beaching is predicted to occur across the east coast of the Shetlands, reaching a maximum mass onshore of 190 kg at 9 days 18 hours after the release.
- The maximum concentration of oil is predicted to be 5.9 g/m^2, well below the ITOPF light oiling threshold (87 g/m^2).



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Cell Contents Environmental Impact

Gradual Release

- Release scenarios will be due to cracks in the concrete and communication paths opening at the existing pipework penetrations, likely to occur 20-1,000 years or more into the future.
- The internal formwork of the CGBS creates 36 smaller compartments in the domes of each of the 75 storage cells. Assuming the failure of one sub-compartment at a time equates to mobile oil release volumes of $0.6m^3$.
- Loss of contaminant will allow a small interchange of the water phase with the surrounding seawater over a longer duration (weeks to months). The release of water into the environment would be an order of magnitude smaller than the mobile oil phase due to the smaller exposure pathways and lack of pressure gradient between the CGBS internal and external environments.
- The sediment and wall residue phases have less of an impact than the oil phase as they are not mobile and are spread over the surface area of the cells. Diffusion into the water column may occur.

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Cell Contents Environmental Impact

Source-Receptor-Pathway Analysis Results

Source	Contaminants	Contaminant Pathways	Receptors	Receptor Pathways	Potential Impact
Mobile Oil	Heavy metals, chemicals, PAH & BTEX	Surface; water column	Seabirds; marine mammals	Physical contact; ingestion	Smothering of birds; bioaccumulation in food chain
Water Phase	Heavy metals, chemicals, BTEX & phenols	Water column	Plankton; fish, cetaceans & seals	Physical contact (adsorption); injection	Bioaccumulation in food chain; plume impact on plankton
Wall Residue	Heavy metals, PAH & BTEX	Benthic (seabed)	Benthic organisms; Epifauna & infauna	Physical contact; ingestion	Bioaccumulation in food chain
Sediment	Heavy metals, PAH, BTEX, chemicals & NORM	Benthic (seabed); water column	Benthic organisms; Epifauna & infauna	Physical contact; ingestion; organic enrichment of sediment	Smothering; particle stress in seafloor sediments; direct toxicity; oxygen depletion; bioaccumulation in food chain

Cell Contents Environmental Impact - Impact Summary

Based on the assessment, the following conclusions were drawn:

- None of the components assessed could be delivered at a sufficient rate, or for long enough duration, to lead to a significant (more than 1%) proportion of the chronic dose in humans.
- None of the components within the cells is capable of concentrating into the food chain in sufficient quantity to deliver an acute dose to humans.
- Only sessile, non-resistant species living on the outer boundary of the contaminated zone will be able to accumulate toxic levels of contaminants. These represent a very small portion of the regional population.
- Modelling of an instantaneous release of mobile oil has shown that it would be unlikely for this inventory to reach the shoreline. At worst, the very North-East coast of Shetland could experience a very small volume of oil depositing on the shoreline but in reality this may not even be detectable.
- It was concluded that the release of the residual cell contents does not constitute a Major Environmental Incident (MEI).

Appendix 8: Evaluation

Stakeholder participants were asked to complete an evaluation questionnaire at the conclusion of the stakeholder workshop, 3 May 2018. This was in order to measure the success of the workshop and engagement from the stakeholders' perspective.

The questions examined stakeholders' level of satisfaction with the opportunity provided to give their views, to gather information and further their understanding. The questionnaire also aimed to evaluate stakeholders' satisfaction concerning whether the issues and ideas they had raised to date had been addressed by Fairfield Energy, and how the workshop process and environment met their needs. In addition, the questionnaire sought to capture any residual concerns that stakeholders might have about the recommendations for decommissioning as presented at the workshop. Both quantitative and qualitative responses were captured.

The workshop was attended by 40 external stakeholders, and 26 completed questionnaires were returned. The responses have been transcribed and collated without attribution, along with the original questions. Please note that participants did not always provide an evaluation score and/or comment in response to every question.

1. How satisfied are you with the opportunity you have had today to give your views? Please select a score from 1 to 5, where 1 is "not at all" and a score of 5 is "very".

Not at all satisfied---Very satisfied

Stakeholders' satisfaction with the opportunity to give their views:

Those that gave a score of 1, made the following comments:

- Given the time and number of people involved, this was as much as can be expected.

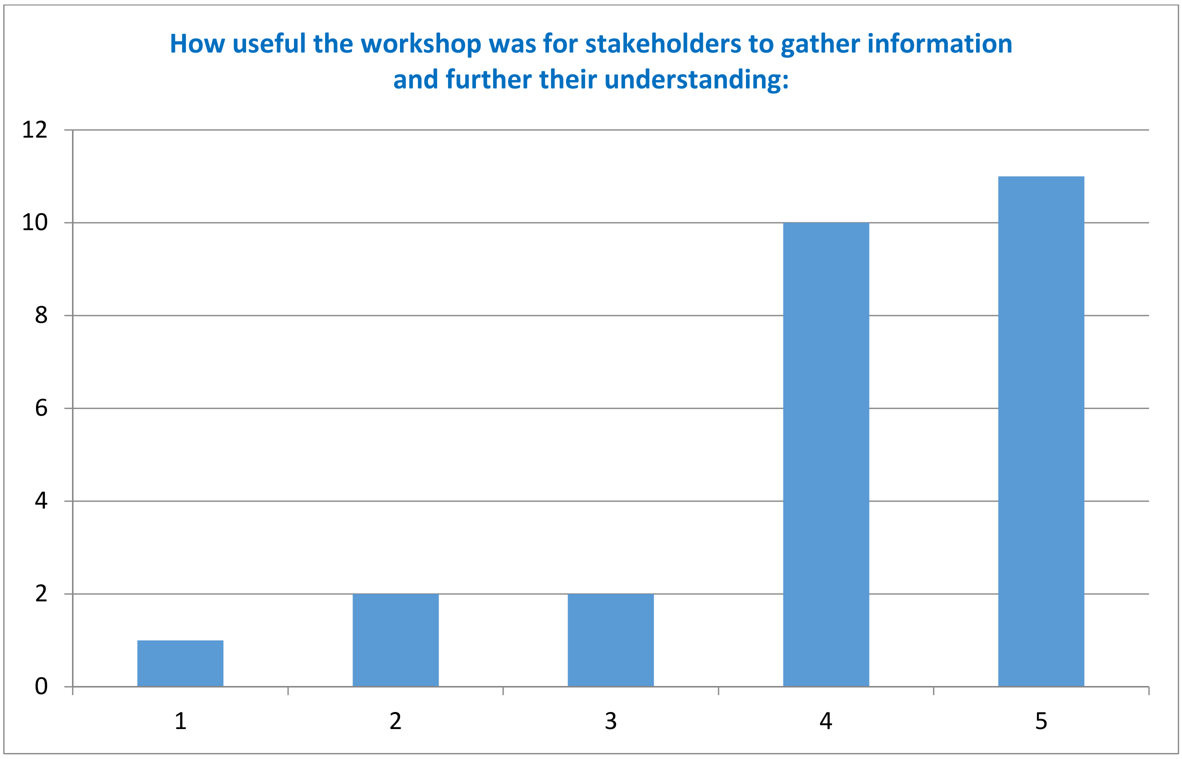
Those that gave a score of 4, made the following comments:

- Good opportunity - only partially limited by time.
- Second go round, plenty of opportunity in the format adopted.
- Open environment encouraging raising and sharing of views. There was an element of time constraint which may have impacted further discussion.
- Good group discussions.
- Enough time 10am - 3pm. Small enough groups at tables to be heard. Enough discussion time between presentations.
- Good [?] presentations. Well run.
- Open conversations. Well facilitated.

Those that gave a score of 5, made the following comments:

- Good to have stakeholder engagement and feedback.
- Good format, and facilitators encouraged questions.
- Very open process.
- Small groups - plenty of opportunity to speak freely without judgement.
- All had a chance to speak.
- Very clear and informative presentations and reports in all main issues.
- Well facilitated and comments collated.
- Very inclusive process - making stakeholders feel welcome to voice their concerns and agreements.
- Good pace, time to digest, consider. Liked the 'comfortable' scale approach to create discussion. Felt this was very open and honest.
- The discussion groups/ workshop and Q&A sessions allowed for views to be both captured on paper and verbally addressed.

2. How useful was the workshop to gather information and further your understanding about the emerging recommendations and decommissioning plans? Please select a score from 1 to 5, where 1 is "not at all" and a score of 5 is "very".



Not at all useful--Very useful

How useful the workshop was for stakeholders to gather information and further their understanding:

Those that gave a score of 1, made the following comments:
- Due to [my] work mostly all this known.

Those that gave a score of 2, made the following comments:
- Very similar to the information provided in the February event, but I do recognise there was a different audience.

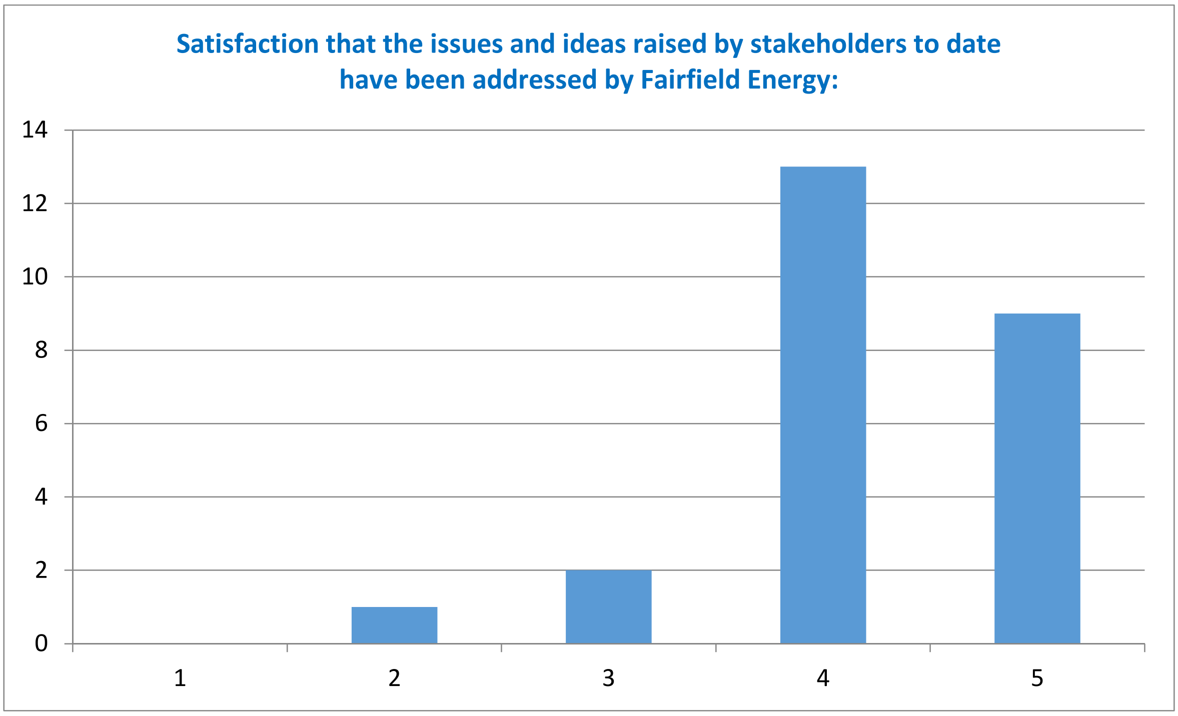
Those that gave a score of 3, made the following comments:
- Supporting "evidence" for cell contents was not convincing. Right answer/conclusion though!

Those that gave a score of 4, made the following comments:
- Good presentations, although could have been more succinct.
- Some of these, I was already aware of.
- Slides and studies available. Again for some people an element of time constraint. Although Fairfield appear willing to consider further requests.
- Posters, presentations, handouts.
- Already informed of work to date due to job.
- Need to read the full comparative assessment to get all details.
- [?] information with good Q&As
- Only con is the understandable limited access to the details behind the summary.
- The presentations and associated documentation that was provided was very detailed. The CA Report also referenced additional supporting documentation which could be assessed if required. Again the discussion groups and Q&A sessions facilitated further understanding through delegate's opinions and queries.

Those that gave a score of 5, made the following comments:

- New to this area and first workshop, so really useful, overview and good level - easy to follow.
- Combined with the pre-read - excellent!
- Well presented.
- Very useful to hear in-depth information about how the conclusions/ recommendations were made. Enabled everyone to see the enormous amount of work that has gone into the recommendations.
- Very transparent. Very slick on response!!

3. How satisfied are you that the issues and ideas raised by stakeholders to date have been addressed by Fairfield Energy? Please select a score from 1 to 5, where 1 is "not at all" and a score of 5 is "very".



Not at all satisfied ---Very satisfied

Satisfaction that the issues and ideas raised by stakeholders to date have been addressed by Fairfield Energy:

Those that gave a score of 3, made the following comments:

- Remains to be seen how issues raised today will be addressed.
- Cell contents issues remain, potentially in the eyes of the public.

Those that gave a score of 4, made the following comments:

- Reference to previous reports and studies and workshops. Fairfield appear open to dealing with issues and ideas that have not been addressed.
- Sincerity to engage came across.
- Good Q&As.
- Always room to do better.
- I think the one anomaly is the general public's perception, however this project is unprecedented and extremely difficult to gauge.

Those that gave a score of 5, made the following comments:

- Good transparency.
- All questions answered.
- All answers responded to openly and honestly.
- Comprehensive presentations.

4. If you have any outstanding concerns that you would like Fairfield to address, please write them here:

- It is in Fairfield's and the industry's interest to articulate their decisions and how they made them in a very accessible way. Relying on a technical process to support the decisions made will not suffice in terms of communication.
- Ensure key public challenges are anticipated and response prepared.
- The structure cells / legs and cuttings piles are all linked - in 250 years the legs may collapse catastrophically, then cells and cuttings piles will be disturbed. Generally more research is required on oil degradation in both the cells and cuttings piles. Long term, i.e. at leg failure, what is the cumulative impact?
- Consider 'future proofing' option 9 by completing leg internal work for an IMO leg cut at later date when technology develops.
- Not a concern, however, I would look forward to a better understanding the technology deployed so far in relation to gaining samples.

5. If you would like a separate meeting with Fairfield Energy, please provide your name:

There were no requests for meetings put forward by stakeholders through the evaluation questionnaire.

6. How well did the workshop process (the ways of working, the working environment) meet your needs? Please select a score from 1 to 5, where 1 is "not at all" and a score of 5 is "very".

Not at all well---Very well

How well the workshop process met stakeholders' needs:

What worked well at today's workshop and why:

- More discussions, less presentations.
- Good chance for all to offer views.
- Presentation and discussion balance was fine.
- Good interaction and discussion. Open environment.
- Skilful enough facilitators.
- No issues.
- Good balance of presentation, discussion and feedback.
- Collaborative approach. Group discussion.
- General format was good.
- Worked well.
- Variety of representatives and questions raised.
- Giving all a chance to speak.
- Clear and comprehensive presentations and reports.
- Format works well.
- Presentations. Collation and discussion of concerns.
- Well organised. Open and frank discussions.
- Good informative presentations. Good small table discussions - enabled everyone to voice their views.
- Breakdown into groups.
- Table discussion and more around for second session was good.
- Simple, effective format: Pre-read, Presentation, Visual Aid, Discussion Groups followed by Q&A.

What could be improved about today's workshop and how:

- Why no major environmental NGO stakeholders in attendance? Have their views been conveyed?
- Longer time for discussion and then summing up and concluding its outcomes.
- More succinct and rehearsed ppts!
- More time allocated.
- Longer time for facilitated sessions and discussion.
- More time for presentations - start earlier.
- Time given to cell contents and comparative assessment needed to be longer.
- Who are the competent individuals to provide you with valid feedback?

7. If there are any stakeholders not present or who were not on the invitation list, who you think should be contacted about Dunlin Alpha decommissioning, please write them here:

- Greenpeace, WWF
- The Scottish Fishermen's Federation would have been good, but I know they were contacted.
- I noticed the Fishermen were invited but not present.
- WWF
- Greenpeace and similar environmental pressure groups.

8. If you have any other comments you would like to make please write them here:

- Always of value to hear first-hand.
- Grand job!
- After the topside section is removed, I'd suggest the legs to be monitored. Structural health monitoring will be a good option.