LCP INSIGHT CLARITY ADVICE

BUSINESS PROPOSAL TO DEPARTMENT OF ENERGY AND CLIMATE CHANGE (DECC)
TENDER REFERENCE NO: TRN967/01/2015
FEBRUARY 2015

Development of a control module to allow DECC to increase efficiency and reduce risk when using the Energy and Emissions Projection models

Our track record of model development combined with our energy sector experience will ensure the provision of the tool best suited to DECC's needs.

Executive summary

LCP provide DECC with the modelling expertise and development capability required to deliver successful, performance-enhancing tools.

Lane Clark & Peacock LLP (LCP) is delighted to submit this proposal for the development of a MS Excel VBA control module to automate the running of several associated Energy and Emissions Projection (EEP) models.

This project will help to improve the efficiency of DECC's analysis and reduce the scope for error associated with existing manual processes.

In order to deliver this project we have assembled a team that has highly relevant, recent experience in the areas of VBA development, energy market modelling and quality assurance, along with a proven track record of delivering similar projects for DECC, wider government and industry.

LCP have an in-depth understanding of this area having developed modelling tools including the Dynamic Dispatch Model (DDM), a key component of the EEP model suite.

Our team has further experience in the area of MS Excel VBA model and tool development, having developed tools across the industry.

Finally our team has extensive experience in providing Quality Assurance (QA) which will be leveraged to ensure the delivery of a robust tool. Team members have previously provided QA of Excel/VBA based tools, including those used by Ofgem and National Grid for project TransmiT and the Capacity Adequacy analysis.

Redacted will lead the project. He led the design and development of the DDM for DECC and has continued to work closely with DECC's internal modelling team to ensure DECC's modelling reflects the latest policy and market developments.

We believe that the combination of LCP's development experience and knowledge of energy sector modelling allows us to offer a robust and comprehensive solution in a cost efficient way, providing DECC with long-term added value.

1. Meeting the specification

1.1. Understating of the requirements

The Central Modelling Team within the Department of Energy and Climate Change (DECC) forecast future UK energy demand and emissions using a set of models called the Energy and Emissions Projection suite (or EEP).

The individual model elements have been developed independently with each making use of the results of other models. To ensure a consistent set of results across all elements of the EEP the models are currently cycled manually until convergence is reached. That is, the models are run in turn by different analysts, with the latest outputs from the other models being copied manually into the inputs. The cycle of model runs is repeated until a stable set of output projections is reached.

This method of operation is both unnecessarily onerous and introduces a risk of manual errors.

DECC seek the development of a control module in MS Excel VBA which will automatically invoke:

- the Energy Demand Model (EDM),
- the Dynamic Dispatch Model (DDM), and
- the Prices & Bills (P&B) model

in turn, passing the relevant data required from one model to the next whilst reporting on progress and convergence.

1.1.1. Key Challenges

- **Usability** – This tool is intended to improve the efficiency of the EEP modelling process. As such it will be important that the tool is easy to use, with inbuilt checks to minimise the risk of accidental user errors. Additionally the provision of information to the user during the operation of the tool will be important to allow for an easy monitoring process.
- **Complexity** – The models to be automated are diverse, complex and require an extensive number of inputs. Monitoring these models presents a challenge to be addressed by this assignment.
- **Data transfer** – While the amount of data to be transferred between the models is not expected to be excessive, this transfer will be conducted iteratively. The ability to track, validate and monitor all the data transferred, when required, will be an essential component of the tool.
- **Future proofing** – The tool developed will need to be robust to the evolution of the EEP modelling into the future. Whether through the addition of new models or new

The key challenges for the successful delivery of this project are:

- Usability
- Complexity
- Data transfer
- Future proofing

interactions between existing models. The ability for the user to easily adjust to these changes will generate lasting value for DECC.

1.2. Proposed solution

LCP propose the development of a MS Excel VBA control (the 'EEP Control Tool') as requested by DECC.

The tool will comprise a user interface, a number of procedures to operate the EEP models and be accompanied by extensive documentation. In the sections below we outline each of these components.

This approach has been designed in line with the following key principles:

- **Ease of use** – The tool shall be structured to be as simple, intuitive and clear as possible minimising the operational burden on the user.
- **Transparency** – The key to successful automation is transparency. All model controls and options will be easily accessible through a user interface, and supporting documentation will be provided covering all aspects of the tool in detail. Feedback on model progress and any errors or exceptions produced by the model will be provided in real-time during the run, and will also be recorded in a log file for post-run diagnostics.
- **Flexibility** – The tool will be designed to be flexible to changes in the operation of the

Key characteristics of our approach

- Ease of use
- Transparency
- Flexibility
- Reliability

underlying models and the requirements of the user.

- **Reliability** – Progress monitoring and automated testing will be employed to ensure robust and reliable operations and results.

1.2.1. User interface

The model interface facilitates the control of the tool. In line with the solution proposed in the ITT we suggest the following structure.

Control tab

The control tab will hold the input parameters applicable to the model iteration as a whole. This is likely to include:

- List and order of models to be run in iteration;
- Whether to keep the results of each iteration, or final results only;
- Maximum number of iterations;
- Convergence criteria to check for each model, at the end of a complete iteration of the models.

The control tab will also contain buttons for the user to execute the simulation process.

Model specific parameter tabs

Each of the models will have a tab containing all the relevant inputs. Example inputs that will be required on a model by model basis include:

- Location of relevant models;
- Inputs to update at initial setup;
- Inputs to update with each iteration (these should correspond to the outputs of the other models within the iterative process);
- Validation rules for inputs;
- Outputs to record;
- Data items to check (e.g. policy flags);
- Action to take on data item failure (Stop, Pause, Continue);
- Outputs to update in UI to track progress;
- Outputs to be checked for convergence.

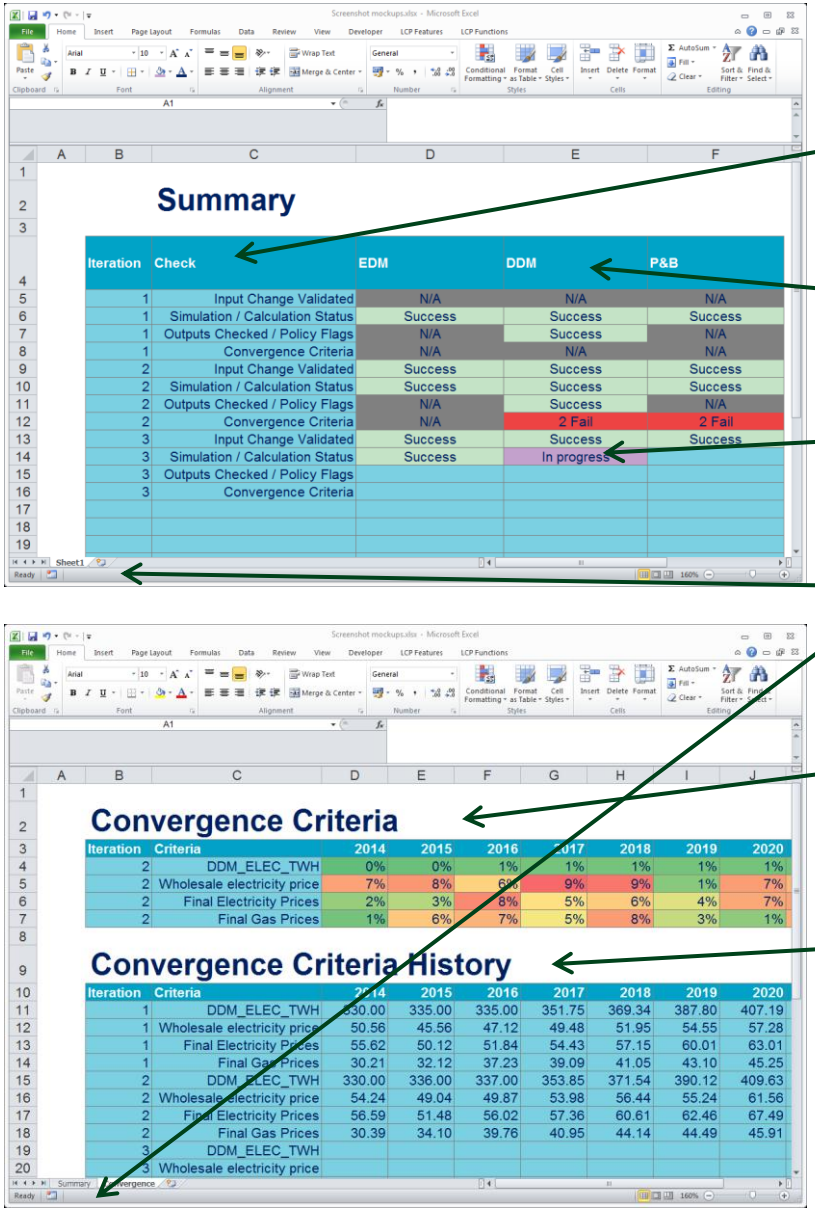
Progress tracking tab

A key component to ensuring the model is transparent and to improving the efficiency of the modelling process is allowing the user to track the progress of the model as it runs.

As outlined in the ITT we would envisage the control tool implementing a rolling grid in Excel, with a new row added for each iteration of the model.

The procedures outlined in the following section allow us to report on each stage of the simulation (e.g. policy flag checks, input validation, convergence criteria), giving the user complete transparency to the operation of the tool and underlying models. An example of the grid is shown to the right, however, this can be tailored to DECC's needs at the outset of the project.

Additionally the ability to track the values of the convergence criteria during the simulation is likely to be useful to the user and we would envisage incorporating this into the progress tracking in a manner similar to the example screenshot included.



Multiple criteria checked per iteration

Column for each model

Current status of simulation

Status bar updates will also be implemented

Difference in criteria at last iteration

Convergence criteria history

1.2.2. Procedures

The procedures the tool will run are covered in detail in this section.

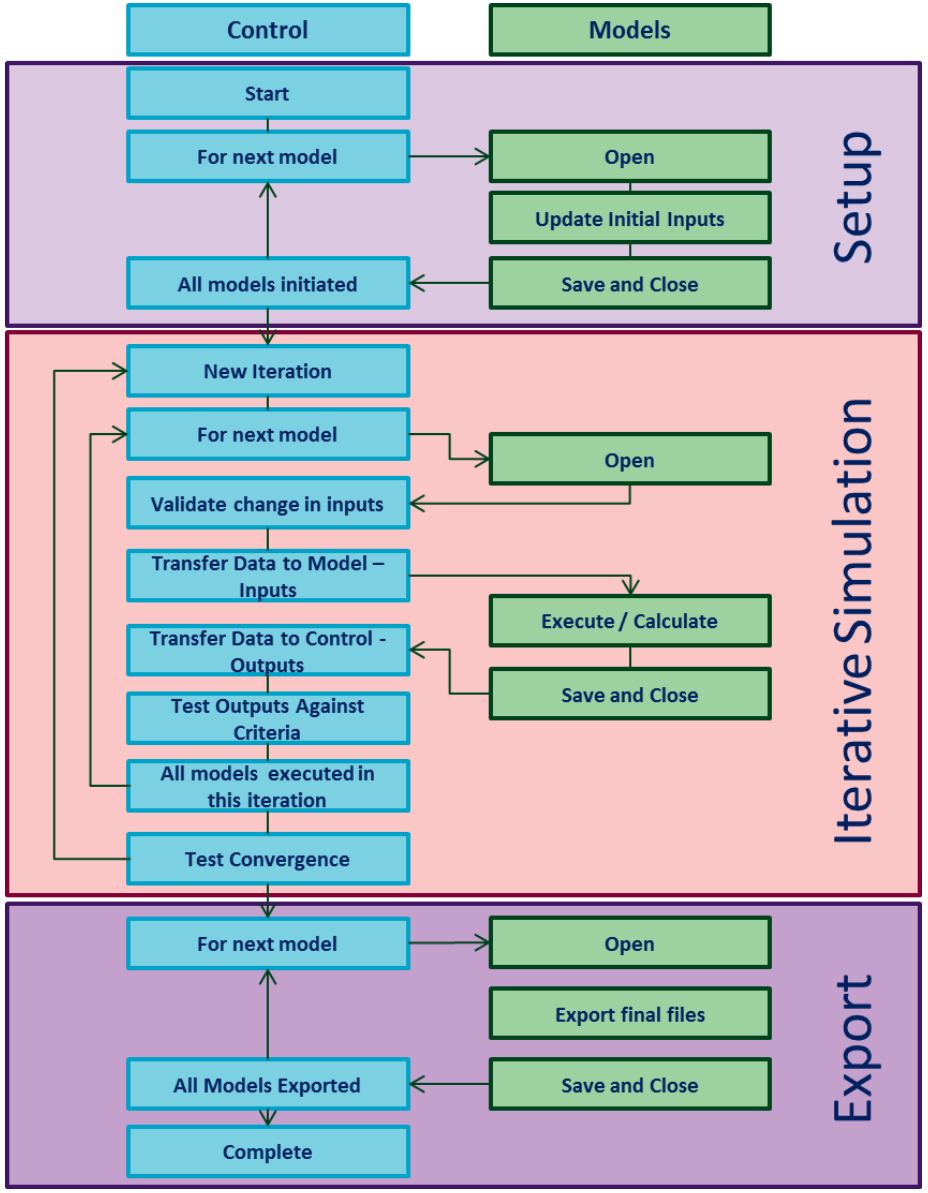
The workflow described in the ITT is specific to the models used and highly prescriptive, in line with the current manual operation of the models. This process can be captured in a holistic approach, where generic procedures and operations cover all the requirements.

An outline of the workflow is included as a diagram on the right.

These generic procedures will allow for the simple expansion of the tool. Following this principle we would envisage these procedures to be agnostic to the model to which they apply (EDM, DDM, P&B), with only slight differences required for the non-Excel components of the DDM.

This will allow the user to easily modify the workflow, for example: changing the data passed between models, altering the metrics checked for convergence, and even adding new models to the process.

Each step in the overall process will be a task to execute one of the procedures with a given set of parameters, for example copying data between ranges.



The proposed procedures are described in detail below.

Update initial inputs

Each of the three models reads in a large number of inputs, many of which are held in separate workbooks.

The initial stage of the control tool will be to update these inputs. This procedure may differ slightly for each of the models. For the Excel-based models it is likely that an 'Update all inputs' function will be added to the models, which the EEP Control Tool can call generically.

This stage will also cover the transfer of EDM assumptions to the DDM input workbook as included in the ITT.

(Note the tool is designed so that the initial input data can differ from the data updated and transferred between the models during the iterative simulation.)

Execute and calculate models

This will differ between the DDM and Excel-based models. For the DDM we would make use of the existing VBA functionality recently developed by LCP to execute the DDM remotely.

For the other models the control can either recalculate the workbook, or call any required VBA within the workbook.

Note we are aware that the execution of the DDM is likely to be the iterative EDM-DDM calculation. All procedures, including transfer of data, will be designed to be compatible with this operation.

Transfer data between models

To ensure the transfer of data between models is as robust as possible, we will establish a generic process for storing and calling the data from each model.

This will be facilitated by creating input and output template sheets in each model's input and output workbooks respectively.

The tool will generically copy the required data to or from the single template sheet, which can then be referenced from within the file. The identification of the data to be transferred will make use of named range functionality or use complete tabs of data as required.

Where input workbooks exist that are separate to the main calculation workbook, an additional procedure may be required after the update to import the data into the main workbook, or copy ancillary workbooks between models (e.g. copy EDM file from DDM iterative simulation to source directory).

This generic approach has a number of advantages:

- Allows for the easy addition or removal of data items being transferred;
- Enables simple tracking of changes to the data inputs;
- Facilitates automatic comparison of inputs to detect anomalous errors;
- Future proofs against changes to the models that may result in the structure of the inputs changing.

Validate transferred data

With the generic input template the option to validate transferred data for calculation errors (e.g. #NA, #VALUE) and user-defined tolerances for the maximum changes allowed can be easily implemented.

The action to perform the detection of user validation errors will be included in the control tab. This will set whether the EEP Control Tool aborts the simulation, opens a prompt asking the user to continue / abort, or alternatively adding a warning to the progress reporting and continuing.

Test outputs against criteria

The generic output template will allow for the simple implementation of checks on the outputs against any user-defined criteria.

This functionality will allow for the testing of the policy flags defined in the ITT:

- Levy control framework,
- 2030 emission intensity, and
- Opted out running hours.

Any other criteria or test required by the user can also be added.

Additionally the convergence criteria of the iterative EDM-DDM simulation can be tested in this way. This can be done in addition to the convergence tests performed on the full EEP suite.

The action to perform the detection failures in the output tests (e.g. levy control framework budget exceeded) will be included in the control tab. This will set whether the EEP Control Tool aborts the simulation, opens a prompt asking the user to continue / abort, or alternatively adding a warning to the progress reporting and continuing.

Check convergence criteria

After each complete iteration of all models convergence criteria can be tested. Again, generic functionality will allow for variables to be checked in addition to those listed in the ITT:

- DDM - GB Electricity Demand,
- DDM - Wholesale electricity price,
- P&B - Final electricity prices, and
- P&B - Final gas prices.

Export final outputs

A number of the models create external output workbooks. A procedure will be created to control this process so that it can be completed with each model iteration or only on the final completion of all iterations.

Update UI and update log file

Procedures for updating the UI and log file will also be required to provide the user with information on model progress and any errors or exceptions encountered.

The data transfer procedures help make this a relatively simple process where the successful completion of each operation and check can be reported in a standardised way.

Section 1.2.3 below describes this process in more detail.

1.2.3. Progress update and logging

A key component to the transparency of the tool will be the progress update and log file creation.

The progress update will allow the user to examine the status of the run and the change in key metrics, particularly against the convergence criteria. Progress will be reported, for each model and for each iteration, on:

- Validation of data success;
- Simulation / calculation success;
- Success of test on outputs (e.g. policy flags);
- Test of convergence criteria (e.g. GB electricity demand, wholesale electricity price, final electricity prices, final gas prices);
- Any errors or exceptions detected.

With all VBA applications LCP also utilise status bar updates to provide the user information on the current operation of the application.

Additionally the ability to track the values of the convergence criteria during the simulation is likely to be useful to the user and we would envisage incorporating this into the progress tracking.

In combination this will allow the user to completely track the progress of the tool's execution.

A log file with more detailed information of the run operation will also be created. This will allow the user to easily examine the stage of the run where any issues occurred.

As part of this development we propose updating the log file generation of the iterative EDM-DDM simulation to produce more information with each iteration and be

compatible with being imported into the EDM control tool log file and progress display.

Please refer to section 1.2.1 for mock up screenshots of potential progress monitoring.

1.2.4. Documentation

Concise and comprehensive documentation will form a key deliverable for this project. Documentation allows for successful knowledge transfer to DECC ensuring users can quickly pick up the tool and developers can maintain or extend the tool with ease.

LCP have extensive experience in developing documentation for all levels of models and tools. The documentation created will be reviewed in the Quality Assurance phase of the project to ensure accuracy and completeness and as part of the user acceptance testing which will ensure it fits DECC's needs.

As requested the test scripts used by the QA team will also be included with the documentation to assist future development work.

The code for the VBA tool will also be open to DECC, commented in such a way as to assist with future DECC development, and covered in the documentation.

1.3. Provision of Quality Assurance (QA)

Quality Assurance (QA) is a necessary and important part of the model development process. LCP have extensive experience of performing model development and implementation reviews across a wide range of industries and have developed a tried and tested approach.

We are particularly aware of the importance of maintaining the high QA standards applied at DECC by following a process consistent with the procedures and principals outlined in 'DECC Quality Assurance: Guidance for modellers' and the Macpherson 'Review of quality assurance of government models'.

An independent expert team member will be dedicated to the QA of the model and will apply the LCP approach as with any external QA project.

1.3.1. LCP's approach to model QA

Quality assurance (QA) is a necessary and important part of the model development process. LCP have extensive experience of performing model reviews across a wide range of industries and have developed a tried and tested approach. We believe there are five key stages to a successful model review:

- **Carefully defining the scope of the review** – to ensure that all aspects of the model are covered, either by our QA or pre-existing testing and analysis.
- **Identifying the highest risk areas of the model implementation** – to focus the review on the areas where errors are most likely to occur based on design of the model from our experience of similar models.
- **Preforming the QA with a focus on the areas of highest risk** – through a combination of formula review, code review, sensitivity/consistency checks and independent replication of results.
- **Verifying and augmenting model documentation** – checking that all documentation is correct and providing an outline of the model's functionality for any areas or formulas that are not explicitly documented.
- **Providing recommendations and solutions as required** – through a combination of proposed resolutions to any issues and identification of areas that would help improve the usability and robustness of the model for future use.
- **User Acceptance Testing (UAT) – t**esting conducted by the end users to ensure that it meets their requirements and checks compatibility with the users' systems. It is also used to check the clarity of documentation.

For this specific assignment an expert member of the team will be dedicated to providing independent QA of the tool and associated documentation, including:

- Design of tool against DECCs requirements. Specifically the tool allows for the complete EEP modelling process, as outlined in the ITT, to be captured and automated in the most efficient manner;
- The tool is adaptable to potential future requirements as discussed with DECC;
- Tool implementation and VBA code;
- Has built-in processes for dealing with common causes of errors;

LCP approach to QA:

- Carefully defining the scope of the review
- Identifying the highest risk areas of the model implementation
- Preforming the QA with a focus on the areas of highest risk
- Verifying and augmenting model documentation
- Providing recommendations and solutions as required
- User Acceptance Testing (UAT)

- Has built-in validation for the range of common risks associated with interoperability between models;
- Completeness and accuracy of documentation;
- Development of test scripts that ensure the successful operation of the tool under a number of different circumstances.

1.4. Assurance of data security

LCP recognise the importance of data security to DECC and when working with government in general. Data protection is an integral part of our operating procedures and forms part of the standard training on joining LCP. We have a published Data Protection policy that all staff are required to read and comply with.

Additionally LCP operates under a comprehensive set of data security procedures that represent a comprehensive plan for ensuring of data security.

Copies of each of these documents are included in Appendix 1 which cover the full range of potential issues identified within the ITT.

LCP propose to operate under the policies listed in the aforementioned documents. Additionally for the purposes of this assignment we would encrypt all models, data, and supporting documents transferred between LCP and DECC as with previous assignments.

If DECC require any further information regarding data security, please do not hesitate to contact us.

1.5. Compatibility

LCP are familiar with the DECC IT environment and the specific setup intended for the EEP suite. We can confirm we see no issues in developing a tool compatible with this environment.

LCP operates under a comprehensive set of data security procedures that represent a comprehensive plan for ensuring of data security.

2. Capability

In this section we provide details of our team and our experience.

2.1. Team

This information has been redacted by LCP.

2.2. Selected experience

This information has been redacted by LCP.

3. Project management

LCP see no issue in delivering this assignment by the suggested date of the 31st of March including time for internal review within DECC and User Acceptance Testing (UAT).

3.1. Progress updates

We would envisage a weekly teleconference between designated DECC staff and key members of the project team. The weekly meetings will allow for progress to be clearly communicated to DECC and the identification of any risks to delivery.

3.2. Risk mitigation

An important aspect of project delivery is risk management. Throughout this assignment LCP would provide an update to risk assessments and mitigating strategies.

At the inception of this project a number of risks and mitigating strategies can be identified.

- **Developed tool does not meet DECCs needs** – This project will entail extensive consultation with DECC on tool development. This should ensure DECCs needs are clearly communicated to developers and incorporated to the tool. Additionally a key component of the quality assurance will be user acceptance testing and independent quality assurance against DECCs needs.
- **Complex nature of models means development timeline is not met –** LCP are familiar with the models used and the development requirements and consider the project plan to adequately allow for development. LCP will continuously monitor development progress and can assign additional resources as required to ensure delivery to DECCs requirements.
- **Developed tool is incompatible with DECC infrastructure –** LCP are familiar with the IT infrastructure at DECC and providing compatible tools. The tool will be developed with only functionality already used within the EEP models (DDM, VBA) and will therefore be compatible with an environment these tools are compatible with.

3.3. Availability

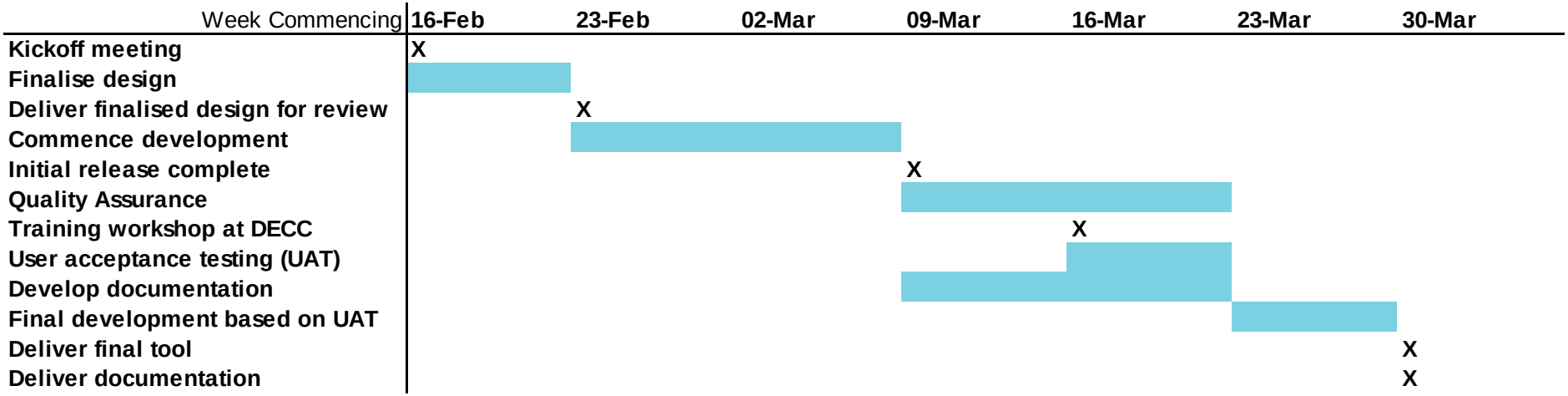
Any team member allocated 3 or more full days in a given week is considered to be full-time on this assignment. For this assignment this will mean the development lead is fulltime for the indicated development period.

We can confirm no issues with availability exist and named staff members will be available for the allocated days.

3.4. Deliverables

- EEP Control Tool
- Complete EEP Control Tool Documentation (User Guide and Technical Guide)
- Training workshop at DECC
- Minor development to DDM reporting

3.5. Project Plan



4. Pricing Schedule

In this section we include the proposed cost of the assignment broken down by team member.

LCP can confirm no additional costs (e.g. travel, expenses) will be charged in the delivery of this assignment.

As outlined in the team structure two separate analysts will be involved in this project and days have been allocated as such.

<table>
<tr><td colspan="3">DESCRIPTION OF SERVICE</td><td>FIRM FIXED PRICE</td></tr>
<tr><td colspan="3">Management & staff and their respective man-days:</td><td rowspan="2">This information has been redacted by LCP.</td></tr>
<tr><td><u>Name & Position or activity</u>
This information has been redacted by LCP.</td><td><u>Cost per day</u>
This information has been redacted by LCP.</td><td><u>No of days</u>
This information has been redacted by LCP.</td></tr>
<tr><td colspan="3">Sub-total/total service cost</td><td>£ 26,300</td></tr>
<tr><td colspan="3">Any other costs (please state)
NONE</td><td>-</td></tr>
<tr><td colspan="3">VAT @ 20%</td><td>£ 5,260</td></tr>
<tr><td colspan="3">TOTAL LUMP SUM PRICE</td><td>£ 31,560</td></tr>
</table>

5. Declarations

This information has been redacted by LCP.

APPENDIX 1: Data Security Policies and Procedures

This information has been redacted by LCP.

LCP INSIGHT CLARITY ADVICE

LCP is a firm of financial, actuarial and business consultants, specialising in the areas of pensions, investment, insurance and business analytics.

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