Appendix B: Conceptual Financial Model for New Reactors

> _**Disclaimer**_: **This draft report was prepared to help the Department of Energy determine the barriers related to the deployment of new nuclear power plants but does not necessarily represent the views or policy of the Department.**

Conceptual Financial Modeling for Reactor Deployment

Overview

- **Background:** Working from the information gained through Tasks 1, 2 and 3, Scully Capital developed a spreadsheet-based financial model to analyze the base case for new nuclear plants and a number of alternative financing structures for the base case, and to estimate the impact of different financing and risk mitigation mechanisms based on plant economics.

- **Objectives:** The key objectives for developing this model included the following:

  Develop a base business case that demonstrates the economics for the addition of nuclear capacity absent government support.

  – Investigate how DOE and industry can work together to manage the financial risks associated with development and construction of new nuclear facilities.

  – Analyze the impact of alternative financing structures, risk mitigation measures, and financing strategies on overall project economics.

  – It is noteworthy that a number of industry stakeholders (e.g., vendors, associations, utilities) have developed similar developmental models. Therefore, one of our objectives was to attempt to calibrate to the results of these models and understand the differences in results (if any) to highlight the sensitivities of the project economics.

- **Section overview:** This appendix presents a description of the following elements of the financial model:

  – Design

  – Functionality

  – Physical Characteristics
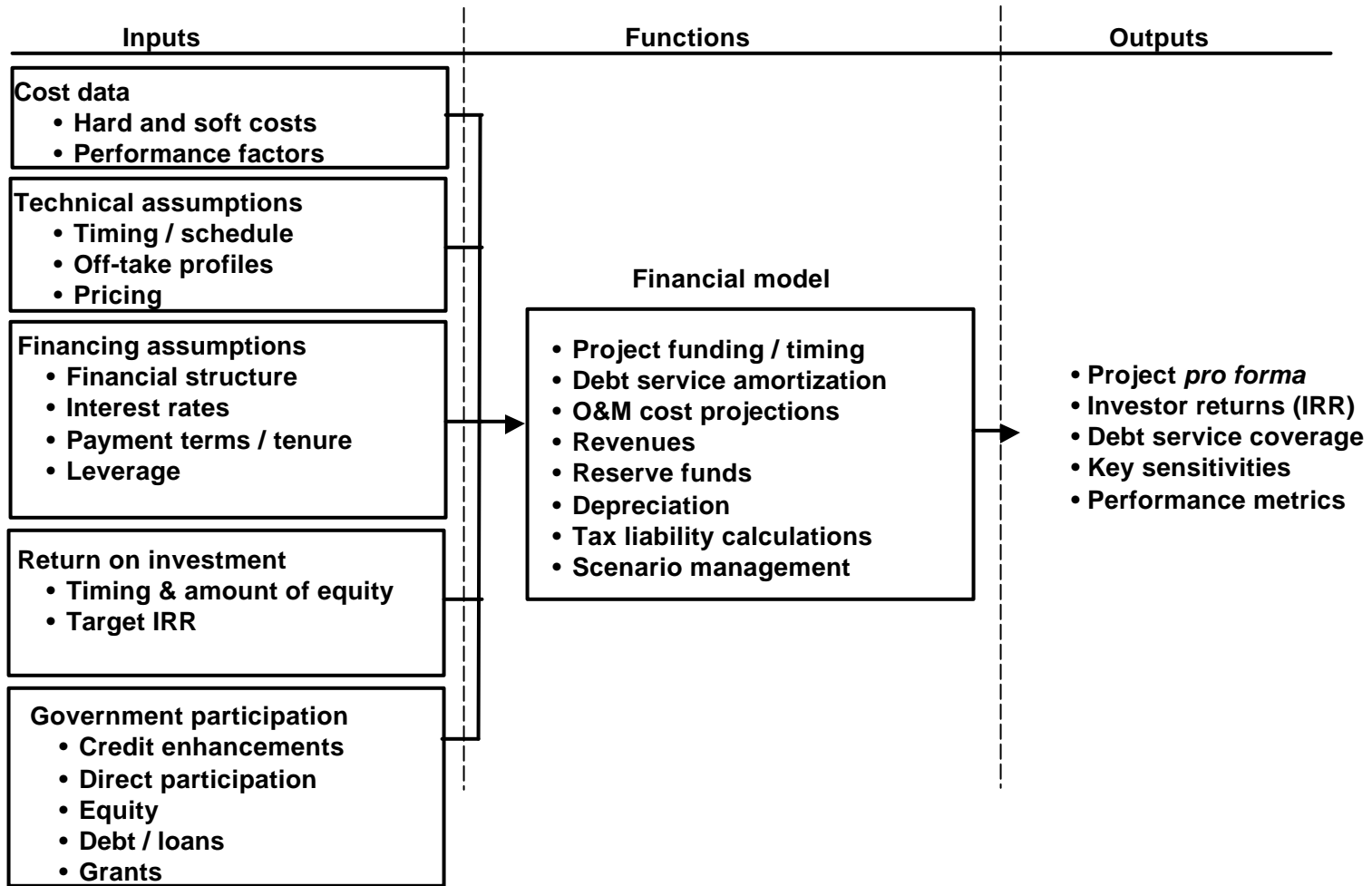
  – Individual Sheet Descriptions.

Spreadsheet Design

Key Design Parameters

- **Approach:** Based on the scope of Task 4 and on our understanding of the intended use of this spreadsheet for sensitivity analyses, Scully Capital incorporated a number of key design requirements into the development of the spreadsheet. These requirements have materially affected the complexity of the model and have provided a foundation for the future enhancements and analysis. Specifically, we accommodated the following key considerations and elements:

  - **Layered Financing Structure:** Since the spreadsheet was developed in parallel with the investigations undertaken in Tasks 2 and 3, the design had to accommodate financing scenarios that arise from the study, as well as future policy development efforts. Therefore, the design of the model contemplated a financing structure that may be composed of different types of debt instruments, as well as potential grant or equity funding by the federal government at different stages of a project's development.

  - **Multiple Scenarios:** A key element of the spreadsheet's design allows users to find and analyze different scenarios without having to save numerous model runs in separate files.

  - **Transparency:** While detailed cell calculations involving nested conditional statements is often a necessity if the model is to accommodate multiple types of inputs, an effort was made to preserve the transparency of the spreadsheet by incorporating interim calculations and providing detailed pro-formas for different elements of project performance. In addition, while the structure of the spreadsheet is protected from manipulation in order to avoid file corruption, the cell formulas and calculations are not protected, allowing them to be displayed and audited by the user.

  - **Flexibility:** Because we recognize that the model and the scenarios it evaluates will evolve over time as new options are considered, we made a deliberate effort to preserve flexibility for future modifications and enhancements. In particular, space has been reserved within the different components in the spreadsheet to allow for future additions.

  - **User Profile:** Based on our understanding of DOE's intention to utilize this model after the conclusion of this engagement, and based on our understanding of the experience of potential users in spreadsheet applications, the design of the spreadsheet has assumed that subsequent users will possess experience in manipulating spreadsheet applications and specific experience in Microsoft Excel.

Overview of Sensitivity Analysis Data Flow

The inputs, functions, and outputs of the model flow are depicted below.

Inputs	**Functions**	**Outputs**

Cost data
- **Hard and soft costs**
- **Performance factors**

Technical assumptions
- **Timing / schedule**
- **Off-take profiles**
- **Pricing**

Financing assumptions
- **Financial structure**
- **Interest rates**
- **Payment terms / tenure**
- **Leverage**

Return on investment
- **Timing & amount of equity**
- **Target IRR**

Government participation
- **Credit enhancements**
- **Direct participation**
- **Equity**
- **Debt / loans**
- **Grants**

Financial model

- **Project funding / timing**
- **Debt service amortization**
- **O&M cost projections**
- **Revenues**
- **Reserve funds**
- **Depreciation**
- **Tax liability calculations**
- **Scenario management**

- **Project *pro forma***
- **Investor returns (IRR)**
- **Debt service coverage**
- **Key sensitivities**
- **Performance metrics**

Spreadsheet Functionality

- The spreadsheet can accommodate 29 separate scenarios that incorporate a corresponding set of assumptions, costs, and inputs.

- Users can select a scenario by clicking on the scenario title in the key results tab of the spreadsheet.

- Changes to scenarios can be accomplished by editing the assumptions behind each scenario or by changing the hard costs, data, and / or timing associated with each scenario (assumptions and data tab respectively). The model will calculate through iteration, one scenario at a time. In order to save the key results of each scenario before recalculation, a macro has been developed that copies certain results and preserves them on the key results page.

Results Sheet
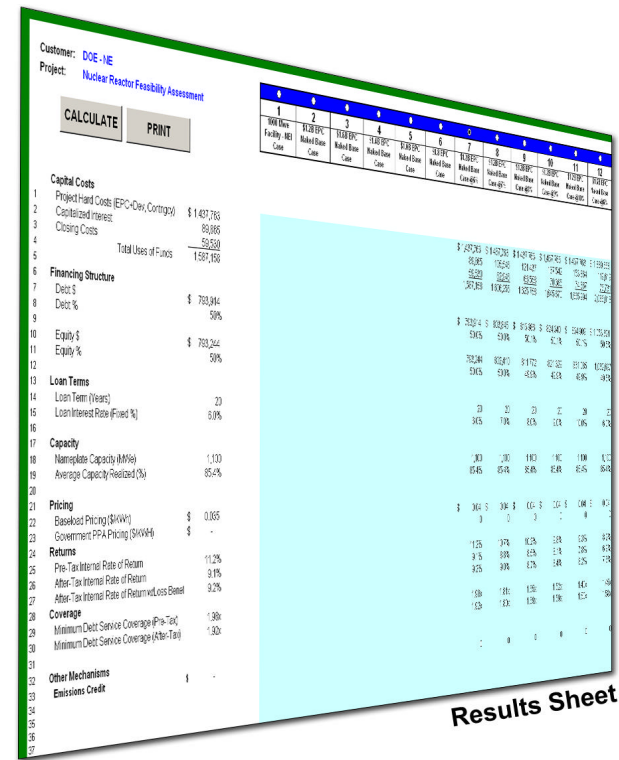
Physical Characteristics

- **Layout:** The spreadsheet consists of eight (8) individual sheets that reference each other but do not link to external files. The extent of each sheet varies with the "Data Sheet" and the "Model Sheet" incorporating the greatest amount of model space. For example, the "Data Sheet" contains over 200 columns and 3,000 rows of information.

- **Size:** The spreadsheet utilizes Microsoft Excel lookup and reference functions in order to "toggle" between scenarios. A limiting feature of one or more of these functions is the ability to run more than 29 different scenarios. Accordingly, the model has been designed to accommodate up to 29 scenarios. If all 29 scenarios are utilized, the size of the model will consume approximately 17 MB of this space. Approximately 8 MB is utilized by the model's underlying logic. Driving the size of the underlying model is our election of aggregating information on a quarterly basis in certain sheets. This decision was made to improve precision, but it adds considerable complexity and space requirements to the spreadsheet. However, this election expands the model's flexibility and provides a foundation for future enhancements.

- **Data Entry:** The model has been designed to require data entry in only two sheets: "Assumptions" and "Data". Subsequent sheets incorporate this data and do not rely on other inputs from the user.

- **Calculation Consistency:** As a general design principle, cell calculations should be identical as they move left to right in the spreadsheet. That is, through references to period counters and data switches, the model applies elements of its calculations based on timing. Due to the fact that multiple scenarios with varying timelines need to be accommodated, conditional statements, rather than custom cell calculations, are used to address timing variations.

- **Circularity:** The model possesses circular logic. Therefore, the calculation of the model requires Excel to be set up in "manual recalculation" mode with iterations set to at least 350.

Data Flow

The model sheets are arrayed in three-dimensional fashion, with data entry sheets providing information to subsequent sheets, resulting in summary exhibits and analysis.
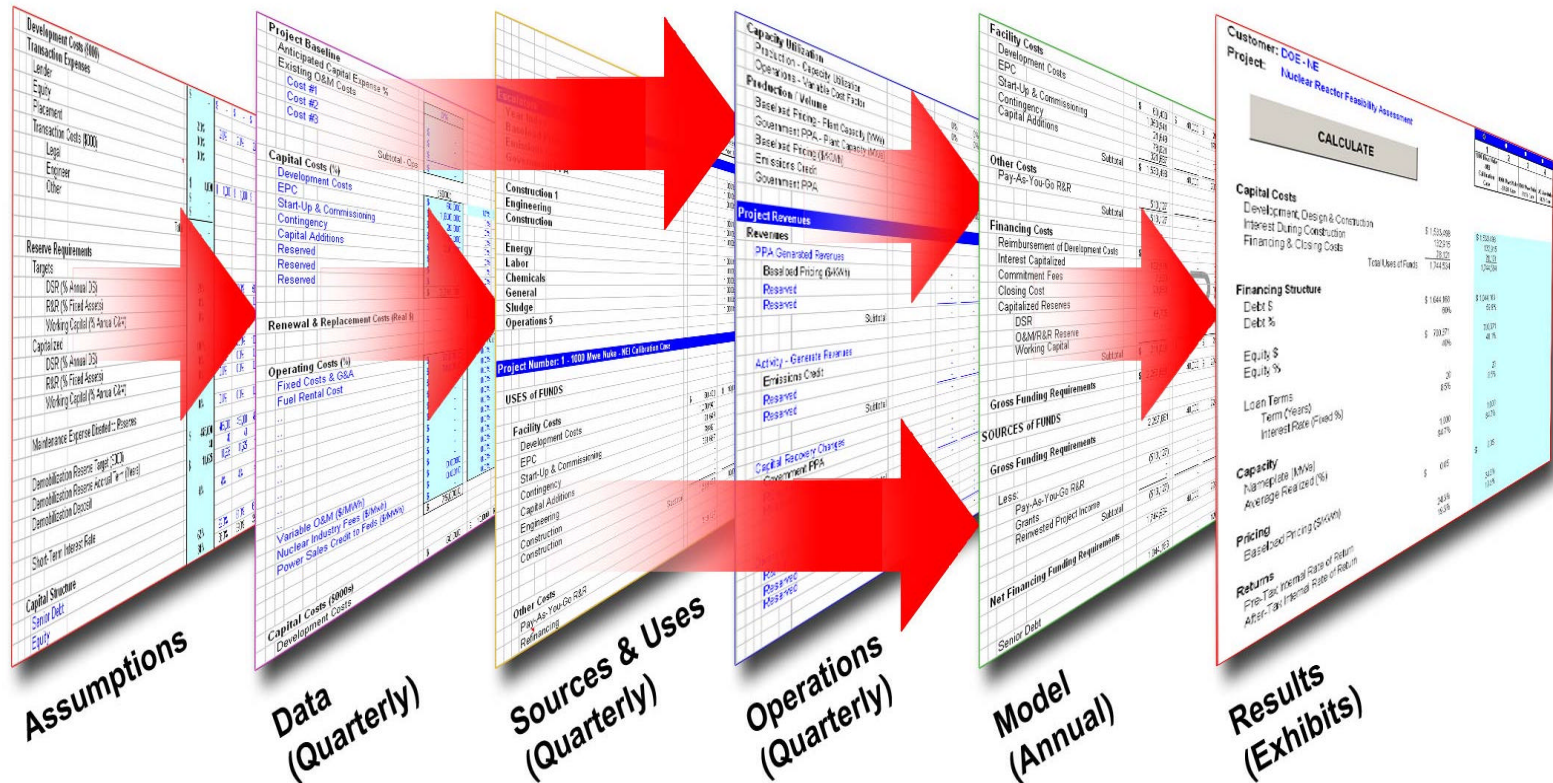
Assumptions Sheet

- **Overview:** The "Assumptions Sheet" is utilized for providing static inputs (i.e., inputs that do not vary across time) for the model to reference. These sets of assumptions are available for the 29 cases. Based on the user's case selection, the specific assumptions related to the case are referenced by the calculation logic of the model. Specific categories utilized in this sheet include the following:

  – Escalation factors: Multiple escalation factors are available for the engineering and construction period, as well as for the operations period. Escalation factors related to revenues are also provided.

  – Taxes: The assumptions relate to property taxes, corporate income tax, and other types of taxes, as needed.

  – Transaction expenses: These assumptions relate primarily to the cost of structuring and placing debt and equity securities related to the project.

  – Reserve requirements: These assumptions relate to the funding of reserves, including debt service reserve funds, maintenance funds, working capital funds, and deactivation and demobilization reserves.

  – Capital structure: These assumptions relate to the targeted capital structure (i.e., debt, equity).

Assumptions Sheet

Assumptions Sheet (continued)

– Grant funding: This category relates to specific model logic developed to address the potential for governmental assistance during the development and construction of the project.

– Debt financing: These assumptions relate to the terms (percentage funding, interest rate, amount available, and amortization term) of three separate tranches of project debt that can be utilized in a model.

– Characteristics / units: This category relates to plant capacity and other production-related characteristics as defined by the user.

– Pricing: These assumptions relate to the pricing of project "off-take" (i.e., sales of power), as well as other options incorporated by the user.

– Working capital requirements: These assumptions drag the lagging cash flow related to funding working capital of the facility.

– Depreciation assumptions: The depreciation assumptions assign the facility's fixed cost to asset classes as defined by the tax code and generally accepted accounting principles.

Assumptions Sheet

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Data Sheet

- **Overview:** The "Data Sheet" provides for assumptions that may change over time. In particular, hard cost data is loaded into the sheet and various switches and percentages are applied in the sheet to manipulate this data over a period of time. Much of the model's flexibility is driven by this sheet. However, significant care must be exercised in loading the specific elements of each scenario. As in the case of the "Assumptions Sheets", the model will accommodate 29 scenarios in the sheet, loading the active scenario into list space referenced by the model's calculation logic. Each scenario consists of the following categories of elements:

    – Switches and counters: These areas of the "Data Sheet" consist of switches, counters, and factors that are applied in the model's calculations. The utilization of these elements adds considerable flexibility to the model's logic. However, sufficient care must be exercised in the setting of these switches to ensure accuracy.

    – Capital cost: This area of the Data Sheet provides for entry of the estimated capital cost of the facility. Estimates are provided in unescalated terms. User-entered percentages are then applied to each category of construction cost to affect a construction draw schedule over a construction period.

Data Sheet

Data Sheet (continued)

– Renewal and replacement cost: To the extent that the facility will require ongoing capital maintenance expenditures, those expenditures should be entered on this line of the "Data Sheet" during the period in which they would be incurred. The entry of these costs will not have a cash impact on the profit and loss statement. However, they are incorporated into the assets of the facility and will be depreciated over time. In addition, the costs entered in this line will be applied to project cash flows during the period of their expenditures. These costs should be depreciated from ongoing maintenance expenditures that will be incorporated in annual operations and maintenance budgets.

– Operating costs: This category refers to the present value operating costs of the facility. For fixed costs, a fixed dollar amount, which is subject to escalation, has been entered; for variable costs, a unit cost amount has been entered. Percentages are adjusted accordingly with the unit costs being multiplied by the plant capacity, which is entered in the following section.

– Total throughput: This section is provided for the user to enter production factors and to vary these factors over time as applicable.

Data Sheet

Sources and Uses

- The "Sources and Uses Sheet" provides a quarterly build-up of construction costs and debt funding and amortization. Specific functions include the following:

  - **Calculation of gross funding requirements:** The calculation of gross funding requirements applies the facility hard costs in the period for which they are set for expenditure and incorporates other elements, such as capitalized interest, commitment fees, closing costs, and capitalized reserves. The capitalized interest cost is calculated within this sheet under the debt section.

  - **Net financing funding requirements:** In order to calculate the amount of funding that would be required in the initial financing, the "Sources and Uses Sheet" subtracts future cash-funded maintenance expenditures, government grants, and reinvested project income from the net funding requirements.

Sources and Uses (continued)

– **Sources of funds calculations:** Based on the net financing requirements and on the availability of specific tranches of debt, the model will aggregate the expenditures of funds by source. Within this section of the model, space has been reserved for takeout financings in the event the analysis of alternatives leads to hybrid structures wherein one type of funding is refinanced by other types. Within the debt section of this sheet, quarterly draws are applied to the balance of each tranche of debt, as appropriate, and interest is calculated on a average balance basis. Based on the capitalization switch in the data page, the interest will be capitalized and incorporated into the gross funding requirements of the project or it will be expensed against project cash flows.

EXHIBIT 1: SOURCE AND USES OF FUNDS ($000)
PROJECT: DOE - NE
Project Number: 7 - Example Case

USES

Facility Costs

		SOURCES	
Development Costs		Gross Funding Requirements	$ 1,587,158
EPC	60,400		
Start-Up & Commissioning	1,261,130		
Contingency	21,649		
Capital Additions	94,585		
	-		
Subtotal	$ 1,437,763	Senior Debt	$ 793,914
		Senior Debt %	57%

Financing Costs

		Equity	$ 793,244
Reimbursement of Development Costs	$ -	Equity %	57%
Interest Capitalized	89,865		
Commitment Fees	9,515		
Closing Cost	15,878	Grant Funding	$ -
Capitalized Reserves	34,137	Grant Funding %	2%
DSR	-		
O&M/R&R Reserve	-		
Working Capital Subtotal	$ 149,395		
Gross Funding Requirements	$ 1,587,158	Total Funds Drawn	$ 1,587,158

Sources & Uses Sheet

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Operations Sheet

- The "Operations Sheet" calculates project revenues and operations costs on a quarterly basis. Cost indices and production characteristics are applied to the unit cost provided in the "Data Sheet", resulting in the calculation of project revenues and expenditures.

Operations Sheet

Model Sheet

- The "Model Sheet" incorporates all inputs and intermediate calculations provided in the "Assumptions", "Data", "Sources and Uses", and "Operations" sheets. It therefore represents the linchpin of the entire model. In cases in which information has been calculated on a quarterly basis, the model sheet summarizes this data into an annual amount. Other calculations are performed within the model sheet due to the annual nature (e.g., income taxes). The model sheet consists of the following sections:

  - **Sources and uses of funds:** This section contains a summary of the sources and uses of funds presented on an annual basis.

  - **Debt:** This section summarizes the three tranches of debt, draw downs, and repayments on an annual basis.

  - **Throughput**: Production volumes are presented here on an annual basis.

  - **Revenues:** Project revenues are aggregated from the "Operations Sheet" on an annual basis and presented in this section.

  - **Operating Costs:** Operating costs are aggregated in this section and presented on an annual basis.

Model Sheet

Model Sheet (continued)

– **Depreciation and Amortization – Tax Purposes:** The depreciation calculations are presented here for the initial cost of the facility and for subsequent maintenance and replacement expenditures. These calculations are based on the asset class selected in the "Assumptions Sheet" and are applied against all capital costs developed in the "Sources and Uses Sheet".

– **Depreciation and Amortization – G.A.A.P. Purposes:** To the extent book income reporting is required in future model iterations, the GAAP depreciation (as opposed to tax schedule depreciation) is calculated in this section for the initial capital expenditure, as well as ongoing capital replacements.

– **Reserves:** The balance's reserve functions are accumulated and calculated in this section. Interest earned on these funds is incorporated into the project income statement and cash flows.

– **Working Capital Movements:** This section of the model sheet calculates working capital requirements of the facility during each year of production.

– **Profit and Loss Statement – Tax Purposes:** Utilizing the information summarized or calculated in the model sheet, this section aggregates revenues and expenses to produce and estimate of pre-tax income. Federal and state income taxes are applied to the extent the pretax income is greater than zero. In cases in which pre-tax income is less than zero, the model assumes that the investors will value tax losses on a dollar-for-dollar basis (i.e., the investors will have offsetting gains).

– **Statement of Cash Flows:** This section calculates the cash flow movements of the project in order to produce the project's estimate of the internal rate of return (IRR). Accordingly, this section combines the capital expenditure of the facility, its associated financing, and its operations profile in order to produce an estimate of cash flows over the timeframe of the project.

Summary

This overview of the model provides background information for the development of the base case and associated scenarios, and for the analysis of the impact of different financing and risk mitigation mechanisms. The results of these analyses of base-case scenarios and mitigant impacts are presented in Section 5.