Engineering information across the lifecycle of LNG assets

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1. INTRODUCTION AND OVERVIEW

Oil prices remain uncertain and waver around the $45-60 per barrel level that seems to be a tipping point for many large capital E&P and LNG projects. Hence, the ability to predict capital costs early in an FEL (Front end loading) exercise is strategic. To do so enables more informed decisions and maintains maximum flexibility as to project design and scope, facilitating analysis of cost sensitivity to various project factors and design choices.

Coupled with that front-end dynamic, the ability to manage and operate the completed asset in an optimum state is of increasing importance. The handover of the appropriate engineering and design basis information and models in a relevant and retrievable fashion are viewed as strategic weapons in the quest to improve asset operation.

The importance of an electronic solution that facilitates a flexible and integrated set of business processes for FEL includes;

- More efficient handover of engineering data sets between engineers, tasks and groups leading to reduced engineering man-hours and compressed project timelines.
- Better capture of repeated design tasks which are common from one unit to another or one project to another saving considerable engineering time as well as reducing variability in the design process.
- More flexible and ready access to the best engineering expertise to attack a particular design task, wherever that expertise may be located on a global enterprise project team or between project partners.

These benefits cumulatively amount to over 30% of the total cost and time of an FEL effort, as documented in several case studies (1) (2).

The importance of effective lifecycle-focused engineering process and resulting handover of engineering information for plant startup, acceptance and operation are also critical and include;

- Design for controllability, flexibility and sustainability
- Design for profitable operation, not just for least cost construction
- Use the very considerable value of the models developed during the design for troubleshooting, operation and improvement of the asset
- Environmental and safety compliance (as-built and management of change)
- Transparency of designs, from beginning to end, to the owner operator

The value to the operator of achieving the lifecycle-focused approach is estimated to approach several percent of the value of the installed asset (3).

2. VALUE OF ENGINEERING SOLUTIONS ACROSS THE LIFECYCLE

A lifecycle-focused engineering solutions approach is critical for LNG projects and other large E&P projects. Increasingly, the partnership teams that are formed for both the front end and detailed design phases of projects are put in place for that specific project. The asset owner needs to put in place a strategy to capture the design basis, data, models and documents that will give him the underlying knowledge to optimize the plant and maximize utilization and uptime.

Decisions made at the very front end of a project will lock in parameters of asset design and configuration and the quality of those decisions will impact the levels at which the asset will perform during its life.

The startup of LNG facilities have often been characterized by process stability challenges which have required dynamic modeling for accurate insight and to make necessary changes to the processes. In many cases, these models are re-built from scratch by the team conducting startup, a major resource and expertise inefficiency.

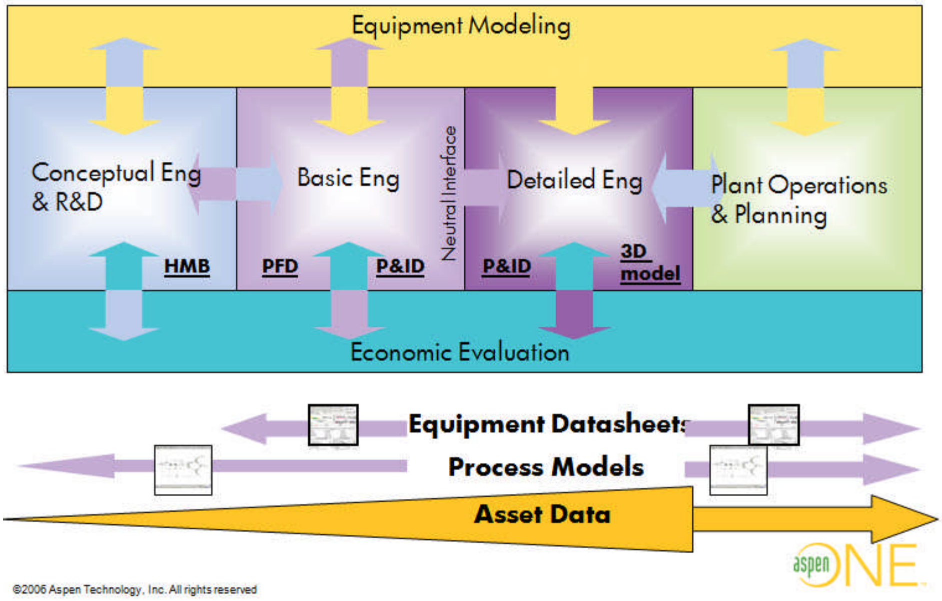

FIGURE 1: Lifecycle view of creation and handoff of engineering information
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There are several points during a project where, traditionally, a documentation package is handed over from one organization to the next. The level of detail and quantity of design information builds up through initiation of construction. At that point a "deliverable" (design package) is produced. The process of producing and handing over that deliverable most typically involves loss of design basis and data in favor of clarity and simplicity of the "documents of record," designed to be used in construction, operation and maintenance.

A more forward-looking approach is to identify the key design bases which add value over the lifecycle of an asset, and then identify the handover systems, data and information that encapsulate these key design bases. The challenge is to present that information in a form which makes sense in terms of the asset operations business processes and needs.

Some of the key deliverables that meet those asset lifecycle values are;

- Rigorous models. Process models, developed in the conceptual engineering phase, can and should be brought forward to form the basis of dynamic, offline and online models for startup, training, troubleshooting and optimization. (4)
- Equipment data sheets. Data sheets, which begin their life at the beginning of the FEED (Front End Engineering and Design – comparable to FEL) process, have lifecycle asset value and should be brought forward through the lifecycle with their underlying process intelligence.
- P&ID. The P&ID follows logically from the process flow diagram developed during the FEED process, and begins life as the preliminary P&ID, typically during the FEL 3 (The final FEL step) stage of a project. Vendor neutral handover methodologies such as ISO 15926 enable electronic transfer of the preliminary P&ID logic and data from the FEED stage to the piping P&ID used in the detailed mechanical design phase.

3. CAPTURING FRONT END ENGINEERING BEST PRACTICES

In the design of facilities for LNG liquefaction and re-gasification, there are a relatively small number of fundamental design options and a small number of processes are considered for selection for an individual project. Thus, the LNG process is an excellent example of "repeatable design." An integrated FEED solution, such as is exemplified by Aspen Basic Engineering, provides the key advantage of capturing a process design as a design package template, that can be re-used on subsequent similar design efforts. The benefits of re-using these existing design templates include (a) saving time and man-hours by avoiding re-engineering units and modules, (b) reducing design variability by re-using "best practice" design parameters and specifications from one instance of a process to the next, (c) capturing design know-how so that less-experienced engineers can make use of the design experience of experts in subsequent instances of a design.

Components of these re-usable design packages may include, (a) process models, (b) plant breakdown structure (c) major equipment design cases, (d) equipment data sheets and list, (e) PFDs, P&IDs and related design diagrams, and (f) conceptual cost estimates.

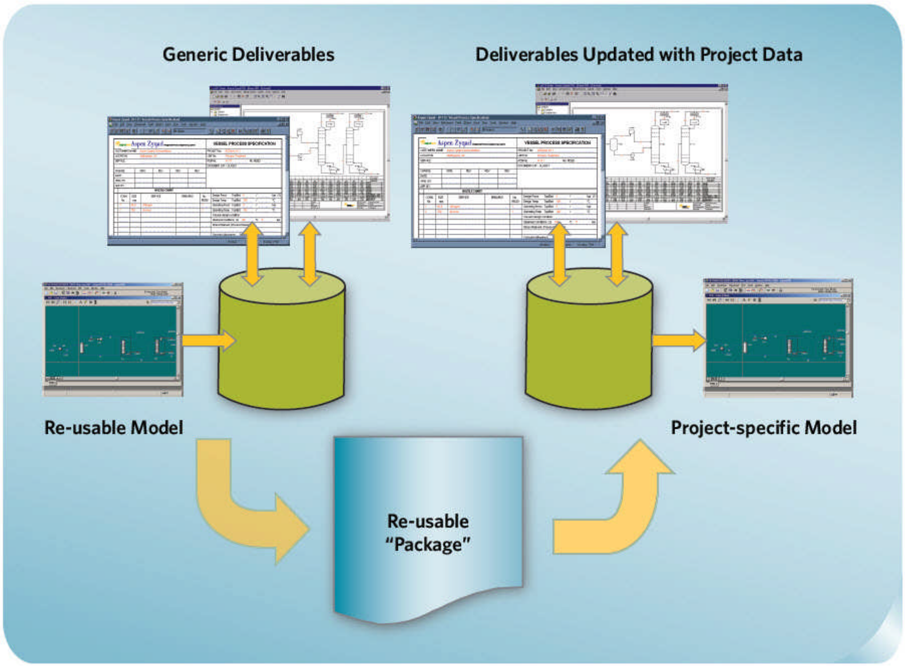

FIGURE 2: Re-usable design templates

3. EXAMPLES

A wide range of project cases, in which AspenTech has supplied technology to and worked closely with EPCs and owner-operators involved in LNG and related businesses, have confirmed the value of pursuing integrated front end engineering as well as a lifecycle asset view.

A few examples follow.

Worley Parsons, a global EPC involved in FEED projects for process assets globally has adopted an integrated solutions approach to these projects over four continents. The result has been an ability to handle a 30% increase in project workload with flat staffing levels.

Jacobs Engineering has performed complex FEED projects involving licensed processes on a repeat design basis, again using an integrated front end basic engineering approach, achieving highly streamlined engineering change processes, on time delivery of challenging projects and significant cost savings.

Osaka Gas employed dynamic models to analyze liquid level instabilities in LNG fractionation towers experienced during startup and early operations. Solutions to operating and control strategies were found, avoiding use of costly bench scale plants, and reducing production costs by $3 million/year.

Saggas LNG employed steady state and dynamic design models to analyze and optimize performance of the emergency shutdown system as well as improve startup and shutdown operating procedures. The analysis provided capital savings through optimal and verified sizing of the venting system. Additionally, the control loops were pre-tuned, improving operating margins by accelerating facility startup.

4. SUMMARY

Integrated basic engineering solutions (typified by Aspen Basic Engineering) combined with re-usable engineering models (such as Aspen HYSYS and HYSYS Dynamics) enable the developers of an LNG project to optimize the design, both from the point of view of capital costs and well as operating effectiveness, early in the design cycle. This approach allows the owner operator and EPC to interact and arrive at the design which optimally meets the owner operator's business objectives. Bringing these solutions forward across the asset lifecycle, provides additional benefits in terms of making the design basis and analytical framework available to the owner operator for startup, process improvement, and asset availability.

NOTES:

1. Tipton, E., and S Mullick, "Focus on Integrated FEED," *Hydrocarbon Engineering* (Jan, 2007).
2. Griffith, J., D. Dietrich, S. Natarajan and R. Beck, "Advances in front-end engineering work-flow and integration," p. 32, *Hydrocarbon Engineering* (Jan, 2008).
3. Snitkin, S, "Asset Lifecycle Management: A Model for Better Asset Information Management. *ARC Advisory Group Research Paper* (Aug, 2008).
4. Hockley, R. and R. Beck, "Achieve Model Operations," *Chemical Processing* (June, 2008).

