Availability Assurance Charter

The Availability Assurance Charter provides a shared framework for integrated companies and Joint Ventures for optimising the design and operation of their production facilities and ensuring that future production commitments can be met. Its scope includes both new project development and expansion projects.

The Availability Assurance Charter spans the whole spectrum of Long Term Planning, Project Development and Operations and its three key objectives focus on improved integration.

1. It facilitates the optimisation of integrated asset reference plans and project development, including both upstream and downstream project phases, which usually requires broad stakeholder engagement and cooperation in between different Joint Ventures in carrying out the studies.
2. It provides context and structure for maintenance planning and optimisation by building strong Asset Management bridges between Project Development and Operations.
3. ARTIS Live provides for day-to-day production availability tracking and reporting, maintenance and production planning and condition based maintenance scheduling by interfacing the Asset Management processes and models with the Engineering and Maintenance Management database systems.

1. Background

Enhancements in project development have squeezed capital investment within the project development and implementation phases to a level where it is now difficult to find areas where further improvements can be made. Attention therefore has shifted to include the operational phase of projects, to consider not just capital expenditure, but the *life cycle project value*, where there is much more margin for improvement. Rising development costs that come with technological innovations have increased the need for this new focus.

Against this background, Availability Assurance provides a coherent framework for the ranking of development alternatives from the perspective of production availability and in the context of optimisation of the life cycle value of the integrated developments.

2. Why

There are solid reasons for including Availability Assurance in project development, both for new developments and project expansions and upgrades:

- Production availability is a key factor impacting on life cycle project value. Future production availability has a direct economic impact on the project cash flow and net present value through its effect on volumes sold and revenues.
- Production availability is universally accepted as key performance indicator and used as a benchmarking measure of operations excellence.
- Many plant operators have contractual supply obligations.
- Availability Assurance is complementary to traditional project development and provides a new and transparent platform for integrated risk modelling and optimisation.

3. What

Availability Assurance is the process for ensuring that plant availability targets are specified, refined, and substantiated throughout the subsequent project development and implementation phases to

ensure that production availability can be maintained to specifications throughout the project operations. This covers both green field developments and debottlenecking and expansion projects and helps to achieve economic targets.

Availability Assurance comprises two groups of processes and tools: one around Availability Modelling and one around Maintenance and Inspection Planning. Experience has shown that designing for required availability levels requires a continuous approach throughout the project phases. The processes aim to optimise maintenance and inspection strategies to ensure that required plant availability levels can be met and maintained cost-effectively. Those aims can best be achieved by a continuous and integrated approach rather than by iad hoc studies.

The full scope of Availability Assurance includes four elements which are developed as the project progresses, including:

- Specification of and adherence to availability targets and requirements,
- Identification and selection of design alternatives to optimise project life cycle value,
- Tracking and reporting of the Production Availability and Technical Integrity of the integrated operations, including the early identification of opportunities for short term sales, and
- Maintenance and Inspection Optimisation, including interfaces with reliability centered maintenance and condition monitoring and risk based inspection.

4. Availability Assurance in Project Development

For assuring plant availability, the project requirements must be fixed at an early stage, to be developed and used in engineering as the project progresses. This is shown schematically in Figure 1.

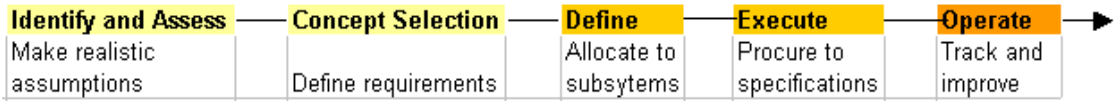

Figure 1*. Availability based requirements in the subsequent project phases*

In the Assess phase, assumptions with respect to the performance of the new installation are made, for instance ‘pacesetting performance’. These assumptions are further defined during Concept Selection and they impact on the economic and technical evaluation, and with that on the decision whether to progress into the Define phase. At the final investment decision, the assumptions change to design requirements, which the project must meet. Therefore, it is important that realistic assumptions are agreed, for both frequency and duration of planned downtime, and for availability between planned shutdowns. This is further completed and implemented in the subsequent project phases to produce a complete basis for maintaining the production availability during the Operation phase.

For the expansion of existing large scale developments, one key outcome of this process is a shopping list showing all Available Capacity bottlenecks in the integrated system that provides focus and guidance for the project development teams in their efforts to assess how the integrated system will be able to meet increased production targets.

5. Availability Modelling

Availability Modelling supports decisions in project development by evaluating design alternatives, such as system configuration and required equipment availability, with respect to their effectiveness in terms of production availability of the system. A single model is used, developed from a system level model in the early phases to a detailed 'as built; version in the Operations phase.

The initial project phases are most important when it comes to life cycle project value optimisation, since there is room to pursue different alternatives. By combining the economic evaluation with availability modelling and capital cost estimating the alternative with the highest life cycle project value can be developed. This means that these activities will not be carried out in sequence, but will be part of an iterative process to come to the optimum solution. This is illustrated in Figure 2. The iterative process requires close communication with the client and the project team.

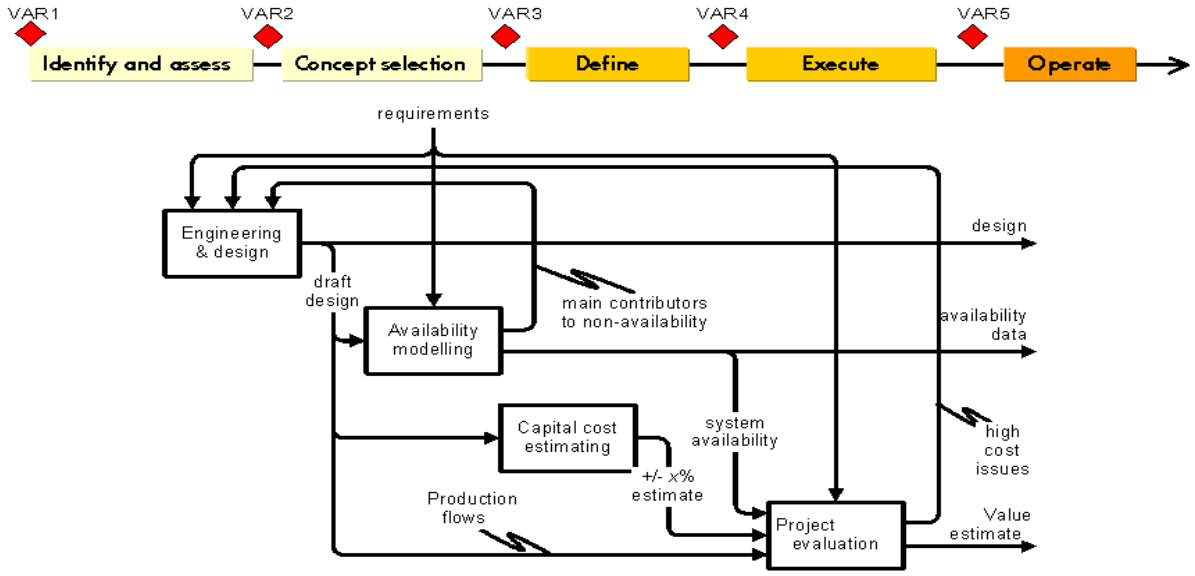

***Figure 2**. Iterative process of designing for availability at optimised life cycle project value*

It is important that the availability study is integrated in the design effort. Based on the assumptions made, system availability, main contributors to non-availability and proposed solutions for deficiencies are determined. By carrying out 'what if' analyses the study can determine requirements for equipment sparing, bypasses, turn-down ratios, etc.

Input to the model are client specific availability performance experience, availability benchmark data, or generic values for availability parameters from industry databases.

6. Life cycle project value optimisation

The economic evaluation of projects will usually be based on life cycle project valuation methods. Three types of cost influenced by plant availability should be included in the life cycle project valuation:

- Capital expenditure, for each of the alternative design configurations that is considered.
- Failure and consequential costs, or cost of lost production and additional cost resulting from failure, such as those resulting from penalties. Such costs can usually be considerable and they should be included in the economic evaluation, so as to obtain realistic evaluation results. In the early phases, these costs are not well defined yet, but a best estimate can be made on the basis of the assumptions made with respect to availability.
- Variable maintenance cost, such as associated with spares, materials, overtime, and contract labour. These (variations in) costs generally are small relative to capital and consequential costs and may be included only during the final project development stages.

Initially, insufficient information may be available to make an accurate estimate of this cost, but information from existing units and experience from elsewhere can be used as an indication.

7. Availability Assurance in Operations and ARTIS Live

By daily monitoring the production availability of the integrated system using ARTIS Live, Operations can respond faster and more accurately to any unfolding risks to production and keep the organisation informed on a continuous basis, enabling a pro-active risk management approach. ARTIS Live provides a full platform for defining, measuring and testing the acceptable risks to manage the vulnerability to possible production shortfalls and ensure highest production availability.

Vulnerability Monitoring requires the ARTIS model with all information on maximum operating capacities of the facilities, their configuration and the operational flexibility and a real time updating process of the planned and unplanned downtime. The state of the equipment is extracted in real time or at pre-set time intervals (e.g. every hour or per shift) from the Production Information system. The updates of the maintenance plans and maintenance completion predictions are downloaded from the

Maintenance Management System. Manual inclusion of further maintenance plans is possible, for example to enable sensitivity studies on the timing of condition based maintenance.

With the ARTIS model, the availability of the integrated facilities is then computed to provide:

- an estimate of the vulnerability to impending production losses
- a look-ahead to quantify the probability and size of imminent unavailability
- a framework for prioritising preventive and corrective maintenance actions

Vulnerability Monitoring serves to enable immediate decisions and actions, for example on mobilisation of backups, mobilisation of maintenance, delay of planned maintenance, and other mitigating measures on an objective and quantified basis in order to enable the risk management of the short and medium term exposure to possible production shortfalls.

ARTIS Live provides an ideal platform for production loss accounting.

8. Technical Integrity Management

The Technical Integrity Management program aims to achieve that the assets are safe, that the management knows it and can show it, not only during audit rounds but continuously and visible for everyone. This aims to achieve that assets are safe to operate and maintain and at the same time minimise planned and unplanned inspection, testing and maintenance downtime.

Developed from the original PACER system, the comprehensive program is built on the state-of-the-art PrimaLux IT solution which provides a shared platform for all disciplines and presents a system wide overview of the full integrity status of the facilities and a rational and transparent basis for optimising inspection and testing plans and schedules. The system is fully integrated across the organisation, with interfaces to all Maintenance Management, SCADA, Inspection and other relevant IT systems to ensure that the management overviews are based directly on the actual measurements and test results, with continuous updates.

This is a revolutionary new approach that takes full advantage of the new IT integration opportunities with fully graphical user interfaces, see figure 3, and has proven its value with large, complex and aging facilities.

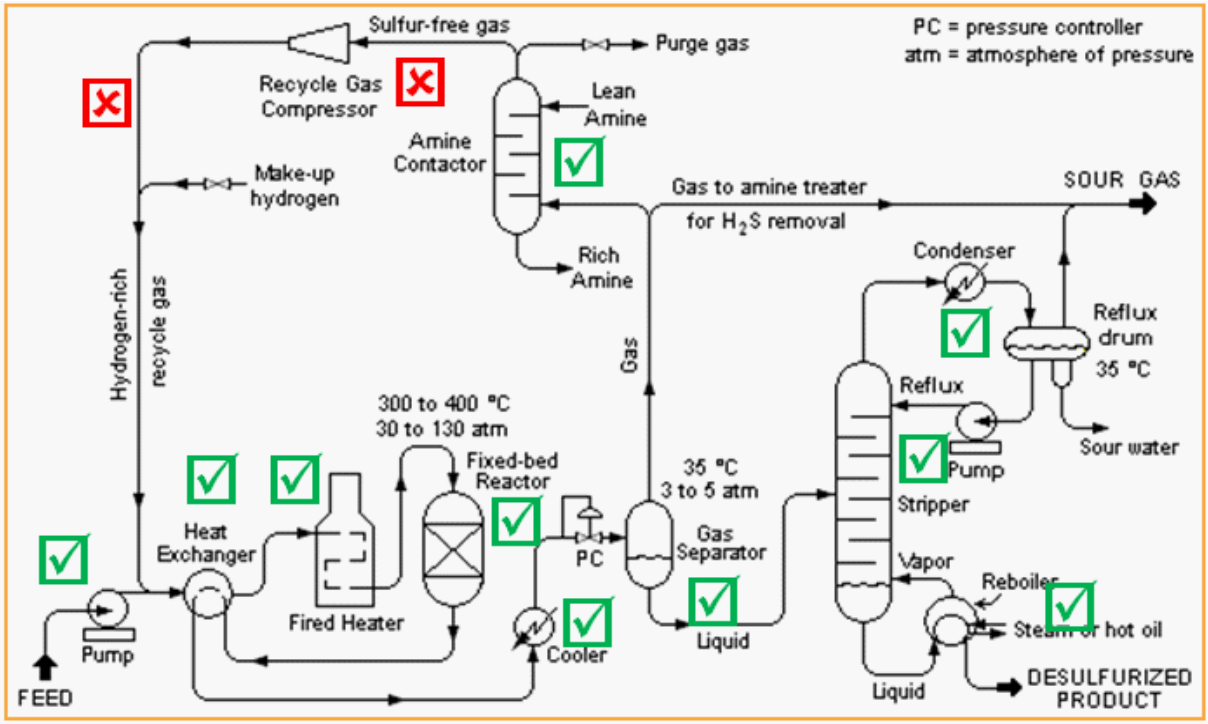

***Figure 3**. Immediate focus on possible areas of risk is key for ensuring safe assets.*