Please direct queries to:

David Stanier
ABB Eutech
Pavilion 9, PO Box 99
Belasis Hall Technology Park
Billingham, Cleveland
TS23 4YS
England

Telephone:  +44 (0) 1642 372295
Fax:  +44 (0) 1642 372111
Mobile:  +44 (0) 7753 831960
Email:  david.stanier@gb.abb.com
Introduction

This paper describes the Asset Life Study concept and the proven ABB Eutech methodology that has been developed to undertake such studies.

A case study of an Asset Life Study for a leading manufacturer of Ammonia and Urea is provided to demonstrate the benefits that can be achieved.
The ‘Asset Life Study’ concept

Today, companies face many pressures to ensure the continued safe and economic operation of their assets. Maintaining Licence to Operate and extending the economic life of ageing plants are typical business imperatives.

Many factors can impact on the situation, such as:

- Economic pressures – how to manage risks and target expenditure on areas of greatest impact?
- Ageing assets – how to improve the reliability and operability of the assets up to and well past their original design life?

Businesses need to proactively assess the condition of their plants and put in place effective asset strategies that support the achievement of business objectives.

The drive in many companies in recent years has been to achieve World-Class standards of manufacturing across all aspects of its operating businesses; inherent in this drive has been the application of asset life strategies supportive of business objectives.

The need for assessing the integrity of an operating asset and the desire to extend its life beyond that for which it was originally designed first surfaced within ICI in the late 70’s and early 80’s. At this time, requests for studies were sporadic and either system or equipment focused, but over time the need for a coherent methodology and the importance of developing a structured and focused approach to the issue of asset life extension became evident. Hence the ‘Asset Life Study’ concept was conceived.

Over the last 10 years this detailed methodology has been further developed and refined by ABB Eutech, following its acquisition by ABB from ICI.

ABB Eutech have completed Asset Life Studies for many companies, and gained considerable experience of extending the life of mature assets in a number of process
technologies, including ammonia and fertilisers, petrochemicals and plastics, chlorchemicals, fine chemicals and pharmaceuticals.

**Asset Life Planning**

A key output from the Asset Life Study is the development of an Asset Life Plan.

Asset Life Planning is a balance between the immediate issues facing equipment and the cumulative effect of these operations over an extended period.

Information required to support the generation of an Asset Life plan needs to address both the immediate and the long-term issues, so providing a balanced picture of the current state on which future judgements can be made.

Fig 1 shows the main constituents of an Asset Strategy. Asset Strategy ties in with overall Business Objectives, feeds down to the essential equipment operating and maintenance policies.

The Asset Life Study process is undertaken in conjunction with the Operating Company to provide an integrated view of the current state and potential longer-term effects. The study processes Asset Care, and Asset Life give this complementary view of the asset condition, and as will be described, provide both information for the current maintenance programme, as well as for long term investment planning.
The Asset Life Study and the Criticality Assessment form a vital part of the overall Asset Management Strategy.

**Asset Care Philosophy**

In a study of this nature it is important to include asset care practices in any Asset Life assessment, because such practices determine to a large extent the life and associated lifetime costs of the asset. With this in mind, the study team need to review operating, inspection and maintenance practices as well as equipment ‘hardware’ issues.

In the reporting of each item the study team identified actions to ensure sustainability of operation and maintenance strategies of key items, based on normal operation. These involve changes to equipment and improvements to asset care practices. However, in a number of cases, equipment problems have been caused by abnormal operational events. These issues have been highlighted, though the investigation of solutions is outside the scope of this study.

In the course of the overall Study, asset care guidance was given to the Operating Company’s personnel. This was done in a number of ways to suit the particular circumstances, ranging from formal training and on-the-job training (such as for the bellows study) through to documents for guidance, and advice given informally throughout the course of the study.

**Asset Life Study Methodology**

The Asset Life Assessment is an overview process in which the construction, history and mode of operation of a large number of items of plant equipment are examined together with the ethos and practices of the organisation(s) responsible for equipment management. The assessment would typically cover all functional areas. However, it can also be focussed on specific areas if desired.

ABB Eutech’s well-proven methodology starts with a careful assessment of asset condition, its operational history and the deterioration mechanisms. Combining these
with historic performance assessments reveals the extent to which the asset is suitable for its intended duty and the expected life before unacceptable performance will occur. The equipment is then categorised, to clearly highlight those items of greatest concern. Costs for anticipated changes are then calculated so that the required investment to maintain integrity over a period of time can be determined, typically over 10, 15 or 20 years.

- **Product obsolescence**
- **New technology development and/or enhancement**
- **Possible plant improvements, such as equipment redundancy**
- **Repair or replace options**
- **Material enhancements**
- **Turnaround Effectiveness**

Assessment of each item is made largely on the basis of information supplied by the plant team either directly or by means of records. The process does not normally involve detailed inspection of operating equipment and judgements are made on longer-term sustainability rather than the immediate integrity or reliability status. The methodology considers the impact of equipment sustainability on operations with issues being
addressed by considerations of reliability, supportability, obsolescence, and maintainability.

In conducting the study, an asset study team is selected based on relevant plant experience and understanding of the main specialist technologies involved, typically comprising the following:

- Vessels engineering
- Piping systems engineering
- Furnace and boiler technology
- Control and instrumentation
- Electrical systems engineering
- Rotating equipment and mechanical handling technology
- Structural and civil engineering

Additional expertise is made available, as necessary, for example materials and corrosion engineering, to provide support to these functions as required.
The Asset Life Study work process is supported by ABB Eutech’s Asset Management Database, which is used to manage the large volume of data that is collected, reviewed and assessed by the Study team.
Case Study – An Ammonia & Urea Plant

Summary

ABB Eutech’s Asset Life Study Process has been used to evaluate the condition of the equipment at a leading manufacturer of Ammonia and Urea. The necessary actions and associated costs have been determined for continued operation in order to provide the business with the basis for forward planning and budgeting. The study has also identified opportunities for improvement of both equipment and equipment management systems.

The study has determined that in general the plant is well maintained by committed and enthusiastic personnel and should run satisfactorily for a further 20 years with replacement of only a relatively small fraction of equipment.

Background

The Operating Company Requirements

Although part of the global market place, each company has its own specific set of circumstances – business objectives and constraints. This is due to its own blend of process technology, plant design, plant age and condition.

The Operating Company are an ISO 9001 accredited company (one of the first to receive this accreditation in the Operating Group). Like all companies following the path to World Class performance, the Operating Company have instituted a number of reliability improvement programmes. However, the Operating Company’s management realised that effective and sustained improvements in reliability need to be viewed in the context of a long term Asset Strategy.

In addition, it was recognised that the Asset Life Study would provide a valuable input to the forthcoming Uprate Project, and the next Turnaround that was being planned.

This is where ABB Eutech provided help.
Asset Life Planning

The plants at the Operating Company are amongst the oldest in the Operating Group, but are not old by world standards where many ammonia and urea facilities are 20 to 30 years old. It has however reached the stage where positive management of age-related deterioration is necessary.

The standard of design and construction of the plant equipment appears to have been good and appropriate conservatism is featured in several of the items examined. Very few items are formally rated as having limited life. The documentation supplied with the original equipment is generally comprehensive and of high quality.

A fairly large number of modifications have been made to the plant, including increased production rate following the uprates. Some new equipment has been added, a few items have been renewed and most of the plant, including the main process trains, is still as originally supplied.

Obsolescence is not yet a major issue other than a few machines.

The maintenance and inspection systems necessary for ensuring the continued integrity of equipment are well focussed and effective, with pro-activity being shown. The plant team appear knowledgeable about their plant and most of the issues affecting its integrity.

Even in this environment of a well run and maintained plant the deterioration of particular equipment items will continue through age and corrosion, and with the increasing production demands other items may be operating outside their design capability. Sustaining plant operations beyond the original design requires a level of strategic reinvestment. Identifying the particular plant items which will need replacement allows the development of an Asset Life Plan and provides the framework for the determination of appropriate equipment and maintenance policies and provides the essential information needed in the normal budgetary and planning processes.
Implementation Strategy

The Asset Life Study covered the whole plant area, namely Ammonia, Utility, Urea and Offsite Plant.

The study included a detailed assessment of

- Asset current condition
- Asset construction and operating history
- Likely deterioration mechanisms and age-related failure of the assets

For Asset Life Study purposes the inventory of the Operating Company’s equipment was divided into seven specialist study areas:

- Vessels
- Fired Equipment
- Piping
- Machines & Solids Handing
- Control & Instrumentation
- Electrical
- Civil and Structural.

Each of these elements of the study was conducted by an engineer both specialist in the topic and with experience of ammonia plant equipment with detailed reports being presented for each topic.

A Criticality Assessment was carried out by the Study Team to provide focus for the Asset Life Study. This assessment can be used as a key input to other asset management initiatives (such as Risk Based Inspection and Spares Management).

The Asset Life Study reviewed and evaluated asset integrity and life assessment based on anticipated Uprate Project operating conditions.

The study also addressed specific issues of concern as detailed by the Operating Company and listed below:
In addition, the study reviewed and incorporated findings from the recent Turnaround.

**Findings**

This assessment has revealed that the Operating Company’s assets are generally in good condition and benefit from effective asset management systems. The assets should continue to give satisfactory service for 20 years and beyond, with respect to safety and production, provided that the present inspection regime, refurbishment policy and overhaul interval continue. However, the study has identified a number of key items of equipment that are of concern in the short and long term, the most significant of which are highlighted below.
Maintaining the plant in full effectiveness well beyond its original design life requires continuing emphasis on asset care - operating the plant within its design parameters and keeping it well maintained. This includes inspection over and above statutory requirements. A process for examining the potential for operational mishaps to damage equipment should also be developed.

To achieve even greater benefit, equipment management practices need to be developed further. There is a need to facilitate study of deterioration trends, as these are the best means of determining and sustaining asset life. Such measures include improved inspection techniques (to provide consistent and reliable data) and continued emphasis on improving personnel awareness and technical expertise.

The technical findings of these studies provided information in 3 categories:

a) Key items where further detailed investigation is needed, for example;

- **Corrosion Under Insulation** - This is the most significant concern for safety and costs of the piping systems, because it has the potential to affect a large amount of piping containing ammonia gas and liquid. Recommendations were provided to ensure that action is taken before the problem becomes widespread.

- **Safety Valves** - A significant proportion of safety valves were identified as suffering from “jamming”, preventing operation at the required pressure. The plant relies on its safety valves, if the integrity of these cannot be assured the plant is vulnerable. A detailed study to investigate the causes of “jamming” was recommended with the appropriate integrity improvements implemented.

- **Storage Tanks** - The study revealed a range of mechanical issues with the Plant’s storage tanks. Failure of these tanks would present significant consequences for production and safety/ environment. Changes were identified ranging from monitoring deterioration to extensive repairs.
b) Quick Wins – where immediate recommendations were made to allow rapid action to improve conditions:

- Bellows review – identification of bellows in deteriorated condition allowing timely replacement at shutdown avoiding failure and significant plant outage.
- Electrical limitations for the Uprate Project project
- Advice given on safety & environmental protection improvements e.g. bunding, handrails, air conditioning system to control room, vehicle barrier protection
- Advice given on cost effective inspection methods
  - Tank settlement surveys
  - Inspection of piping
- Risk-based approach to blast protection of buildings
- Advice given on the importance of steam trapping steam mains

c) Technical Improvements – detailed technical comments made for future actions to avoid or reduce deterioration rates, and identify potential investments needed for sustainability.
In taking a long-term view of the Operating Company’s assets, it is important to consider the impact of assets owned by others that effect the operation of the plant. Such assets include the jetty and natural gas pipeline. Although these were not in the scope of this study, it is recommended that the Operating Company satisfy themselves that active asset management systems are in place by the respective Owners/Operating Company.

**Benefits to the Operating Company of the Asset Life Study**

The Asset Life Study provided a range of benefits to the Operating Company:

1. **Management attention - independent view**
   
   The Asset Life Time study provided a long-term view of the sustainability of the assets based on industry experience of similar plants and process operating greatly beyond their design lives.

2. **Flexible approach**
   
   The study approach needed to adapt for logistical issues concerning both the timing of the plant shutdown and availability of key personnel.

   Newly gathered information from the shutdown was introduced into the study reviews to provide the Operating Company with a contemporary review of the current equipment condition.

3. **By focusing on the long term, the production of annual budgets is greatly facilitated.**

4. **Captures plant history and experience of plant personnel.**

5. **Cohesive view of what the future holds.**
   
   Where & why deterioration is taking place.
   What is needed to maintain equipment integrity.

6. **Life Cycle actions and budgetary plans – investment to prevent failure rather than as a reaction to it.**

7. **Improvement of operating & maintenance practices.**

8. **Demonstration of pro-active management of assets.**

9. **Reduced risk of HSE incidents.**
Next Steps

Development of Asset Life Plan – specific actions, focusing on next 6 years

Focus on specific immediate problem areas (e.g. Corrosion under insulation).

Conclusions

The study has tailored an established methodology developed by ABB Eutech to provide a structured review of all the process and associated utilities and offsite assets. By focussing on issues that are less well known by the plant team, as well as reviewing known problem areas, the study team has carried out a specialist assessment that includes experience in the ammonia industry and wider petrochemical industry.

The Asset Life Study has revealed that the Operating Company’s assets are generally in good condition and benefit from effective asset management systems. The plant team are committed and enthusiastic and are knowledgeable about the plant and most of the issues that affect its integrity.

The assets should continue to give satisfactory service for 20 years and beyond, with respect to safety and production, provided that the present inspection regime, refurbishment policy and overhaul interval continue.

The study has identified a number of key items of equipment that are of concern in the short or long term. Some issues require further study in order to develop optimum solutions.

The study has identified opportunities for improvement of both equipment and equipment management systems.

The study has provided timely and valuable input to a planned Uprate Project and the Turnaround preparations.
The study has provided a range of deliverables including a Criticality Assessment, a bellows study and training of the Operating Company’s staff, and Asset Life Databases.

- The Criticality Assessment provides a vital foundation for a range of further Asset Care initiatives, such as Risk Based Inspection studies.

- The Asset Life Databases summarise all the key data used in the course of the study, and the actions and recommendations that were generated. These databases are being updated by the Operating Company to manage their asset history.

For further details please contact:

David Stanier
Telephone: +44 (0) 1642 372295
Email: david.stanier@gb.abb.com

Laza Krstin
Telephone: +44 (0) 1642 372384
Email: laza.krstin@gb.abb.com

Jeremy Lewis
Telephone: +44 (0) 1642 372017
Email: jeremy.lewis@gb.abb.com