‘Doing the right thing – putting safety first’ is one of our core values. This includes the fundamental goals of achieving inherently safer design in all of Amec Foster Wheeler’s engineering and construction efforts. Amec Foster Wheeler’s Safety by Design process assists the achievement of designs with enhanced safety and environmental characteristics. This process is based on the implementation of Inherently Safer Design principles applied to engineering, construction and their environmental aspects.

Amec Foster Wheeler applies a Safety by Design process on its engineering projects, designed to help our engineering and design teams, focus on the impact they have on operations and construction safety, and how we can improve in this area. The intent of Safety by Design is to:

- Address life-cycle health, safety and environmental risks and environmental aspects including management of the use of natural resources in development projects.
- Systematically and comprehensively identify and assess hazards and environmental challenges, and their associated risk to people, environment, asset and production loss, and company reputation.
- Examine whether actual and potential negative impacts can be entirely avoided, or their magnitude reduced by design. If this is not possible then appropriate and preferably engineered controls (ie by isolating people from the hazard by use of enclosures) shall be put in place to manage the residual risks and environmental impacts.

Amec Foster Wheeler has made Safety by Design an integral part of the project engineering design workflow. In addition, we have dedicated resources in our key engineering centres that are actively involved in ensuring Safety by Design.

Why adopt a Safety by Design approach?

In addition to making a facility safer, adopting a Safety by Design process can save costs:

- Inventory reduction will reduce costs because smaller vessels cost less.
- Simpler plant costs less because there is less equipment and fewer ancillaries.
- Avoiding hazards also prevents the costly hazard control measures.
- Reducing count, size and complexity of equipment reduces utilities, labour, testing and maintenance costs.
A five-step process

1. Define safety goals
   Goals will help maintain focus throughout the Safety by Design process. Goals should reflect regulatory requirements, legislation and project-specific tolerability of risk criteria and sustainability strategies, as well as project-specific safety and environmental goals.

2. Understand hazards & aspects
   If hazards to health and safety or the relevant environmental aspects that require management are not known, they cannot be controlled. The purpose of this step is to identify and understand project specific health and safety hazards as well as environmental impacts.

3. Implement Inherently Safer Design principles
   The intent of Inherently Safer Design is to eliminate a hazard or the use of materials or energy completely or reduce the magnitude of use sufficiently to eliminate the need for elaborate safety or environmental management systems. This process of elimination or reduction is accomplished by means that are inherent to the production process and thus permanent and inseparable from it and therefore highly reliable. The implementation of Inherently Safer Design is achieved by adopting a strategy based on the following principles:
   • Eliminate - remove hazardous materials, processes and activities.
   • Minimise - use smaller quantities of hazardous substances and materials generally; minimise the number of activities especially hazardous ones.
   • Substitute - replace a hazardous, expensive or rare material or activity with one that is less so.

4. Manage residual risk
   If ‘inherent control’ cannot be fully achieved or is perceived to be inadequate, residual hazards, risks and environmental impacts will remain and their associated risks and effects will need to be reviewed, and where reasonably possible, mitigated. Mitigation may require the implementation of additional engineered or procedural controls.

   Controls or safeguards are generally more effective if they prevent a hazardous event or unnecessary use of materials or energy from occurring by passive means, rather than reactive means, ie acting on the consequences of events rather than preventing the events. Engineered controls are generally preferred to administrative controls, as these require no, or less, human intervention to be effective.

   The preferred hierarchy of controls is reflected in Amec Foster Wheeler’s Safety by Design process, and subprocesses that address health & safety and environmental protection & sustainability issues.

   Various studies can be conducted as part of the residual risk management process, either in-house or with external support. These studies could include the review of:
   • Operability and safety of processes involving hazardous materials.
   • Effectiveness of safety instrumented systems as a safeguard.
   • Analysis of the possible failure of equipment and the potential impact of this failure on people and the environment.
   • Effects and likelihood of releases of hazardous materials.
   • Effects and likelihood of fires, explosions and nuclear radiation, and mechanical impacts such as dropped objects and collisions.
   • The minimisation of the use of resources (eg water) and energy (eg electricity, diesel fuel).
   • Human-machine interface and human-friendly design.
   • Effects and likelihood of potential human errors.
   • Escape, evacuation and rescue process.
   • Evaluation of risks to people and the environment, asset-production loss, effects on community, habitat and natural heritage.

Fact sheet

Define safety & environmental goals
Understand hazards & environmental impacts
Implement inherently safer design principles
Manage residual risks & environmental impacts
Consolidate & communicate

Amec Foster Wheeler’s five step Safety by Design process

- Moderate – minimise the potential impact of a release of substances, materials or energy, eg by changing layout configuration, adopting less hazardous operating conditions, or by minimising the number of people exposed.
- Simplify – design facilities and plan executions to reduce or eliminate complexity and minimise the possibility of human error.
5. **Consolidate and communicate**

Once the Safety by Design process has been completed as intended, and the goals that were identified at the outset of the project have been met, the process can be closed. The findings of the Safety by Design process can be consolidated and communicated to internal and external stakeholders.

Depending on legislative and client requirements, a dedicated compliance report such as a Case for Safety or an Environmental Impact Statement is produced.

**Managing actions and recommendations**

Any action or recommendation raised during the project’s Safety by Design process is recorded and followed up.

Following up these actions can be complex, as it requires multiple parties to be involved, either as responsible party or in an approving capacity. Our SharePoint-based engineering and technical action tracker (ETAT) has been specifically developed to address these types of actions.

**Developing and maintaining an Inherently Safer Design culture**

For the benefits of Inherently Safer Design to be fully realised it is important that the entire project team becomes aligned with the need for it. To support this, in conjunction with the Amec Foster Wheeler Academy, a two-day training program ‘The Essentials of Safety and Environmental Protection through the Asset Life Cycle’ has been developed and is presented in global locations several times a year. The objective of the training is to explain the principles of the Safety by Design process to our engineering community.

In 2015 we began utilising 3DS Max on some of our high risk projects.

The software is extensively used in video games, films, television and commercials, including the Oscar-winning film Avatar. 3D animation was originally introduced to the world by Pixar in the film Toy Story. 3DS Max provides a comprehensive modelling, animation, simulation and rendering solution.

The use of 3DS was first introduced within Amec Foster Wheeler on the BP Clair Ridge Project. Its success, followed by further success on GDF Cygnus projects showed that this software had the capability to animate to a level of detail that would aid in our Inherently Safe by Design process.

3DS Max provides us an increased awareness of ISD by graphically representing the effects of what can go wrong and how to efficiently design to stop problems before they occur.

By animating a small design feature to eliminate a potential risk to a structure failure explosion (based on calculation results), 3DS allows us to realistically replicate the damage of an explosion and how it affects its surrounding area.

The detailing of an explosion and fire temperature levels that can critically fail structures, such as metal and concrete, are enhanced through the ability to show the density and dispersion of smoke from an ignition point. This allows a great insight into how we can design facility layout and for example where to position the accommodation modules.

Heat can also be animated to show how paint is designed to protect the metallic structure that it is covering as well as heat flowing through a heating, ventilation and air conditioning (HVAC) system, which on release into the air can affect the approach of a helicopter towards an offshore installation. 3DS not only details manmade elements but can also program-in the effects of seasonal weather for wind and sea.

We will continue to develop our use of 3DS Max further in the long term for offshore inductions and safety reviews.