Applying inherent safety to the design of new processes provides an opportunity to remove hazards at source, making plants safer whilst potentially reducing the overall lifecycle costs.

‘Inherent safety’ principles were developed in the 1970s by Trevor Kletz of ICI, who coined the phrase ‘What you don’t have, can’t leak’. The ‘inherent safety in design’ (ISD) approach has more recently been promoted in guidance from the UK Energy Institute written by ABB Principal Consultant Graeme Ellis. However, there still appears to be a lack of awareness amongst design teams and a tendency towards ‘add-on’ safety systems to reduce risks to ALARP, generally resulting in facilities that are more expensive to build and operate.

Project management should ensure that systems are in place to challenge design teams to identify opportunities to improve the inherent safety of a process. For example, increasing the wall thickness of a pressure vessel to contain the maximum foreseeable pressure may marginally increase the cost of the vessel, but will probably reduce the overall installation costs significantly, avoiding the cost of a high pressure trip and pressure relief system, plus on-going inspection and maintenance of these ‘add-on’ safety systems.

The requirement to apply inherent safety as part of a hierarchy of hazard management approaches can be found in international legislation. For example, the UK HSE states in its guidance for offshore safety cases, ‘The safety case should explain how inherently safer design concepts have been applied in the design decisions taken.’ Although benefits can arise throughout the lifecycle of a facility, the major benefits from application of ISD are during the early stages of design when the opportunities for change are greatest, as shown on the diagram (figure 1).

**What we offer**
ABB Consulting encourages inherent safety thinking at all stages of the design process, including traditional HAZID and HAZOP studies within ABB’s ‘6-stage hazard study process’. The overall approach for projects is shown on the diagram (figure 2) taken from the Energy Institute guidance on ISD.

It is recognised that the greatest opportunity to benefit from ISD exists during the early conceptual design stage, particularly for projects where new process chemistry or technology is being introduced. In these cases an ‘inherent safety workshop’ is carried out (sometimes known as hazard study ‘0’), to provide a structured approach to identify improvement opportunities.

ABB provides a process safety specialist to facilitate an inherent safety workshop involving a multi-functional team. The workshop is based on Process Block Diagrams (PBD) for all potential process routes, showing the expected substances, inventories and design conditions.
Hazardous events are identified at each block based on the hazardous nature of the substances involved and related to foreseeable loss of containment / release of energy events. The team are then challenged to remove or reduce these hazards by fundamental re-design of the process, rather than resorting to ‘add on’ safety features, by applying the following inherent safety principles:

− Elimination
− Substitution
− Minimisation
− Moderation
− Segregation
− Simplification

The inherent safety workshop provides a detailed record for each process route option showing potential improvement options, with initial assessment of the practicability and cost versus benefits. Follow up work is then carried out by the design team to work through these options and develop the most inherently safe process design, only resorting to ‘add-on’ safeguards to reduce risks where absolutely necessary.

Benefits
The application of ISD throughout the process design process offers the following benefits;

− Provide process designs that are fundamentally safer with hazards removed or minimised rather than controlled by ‘add-on’ safeguards
− Potentially reducing the overall lifecycle costs by avoiding the cost of installing and maintaining safety systems
− The principle of ‘minimisation’ encourages reduced inventories of substances, and hence smaller and lighter equipment with reduced capital costs
− Meeting the demands from regulators to demonstrate that the hierarchy of control measures have been applied with improved chance of gaining approvals
− Changing the mind-set of design teams to search for opportunities to remove hazards throughout the facility lifecycle

Why ABB?
ABB Consulting has been heavily involved in the development of inherent safety approaches within the process industry. The concept was ‘invented’ by ICI in the 1970’s and is engrained within ABB’s ‘6-stage hazard study’ process. More recently ABB was a member of the EU funded ‘INSIDE’ project in the 1990’s developing inherent safety tools, and authored the Energy Institute guidance on ISD published in 2013.

ABB consultants have a wide and deep experience of identifying hazardous events on process plants, and providing pragmatic advice from years of design and plant based experience. This knowledge is used to challenge design teams to search for improved process designs that will reduce the need for time consuming demonstrations of ALARP at the later stages of design and operation.

ABB is a proven leader in process safety, offering a wide range of consultancy and training services, which address the way in which people, plant and systems inter-relate to ensure effective Process Safety Management (PSM). As a follow-up to inherent safety workshops, ABB can provide further support during the design process including; HAZID / HAZOP studies, SIL Determination / LOPA, quantified risk assessment, pressure relief design, hazardous area classification, safety critical task analysis, etc.

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