

SAND2012-7065C

Life Cycle Concerns

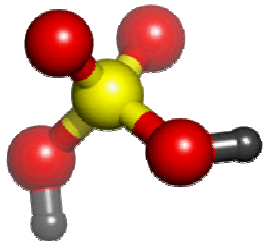
Nairobi, Kenya
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SAND No. 2102-7065C

Sandia is a multi-program laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.



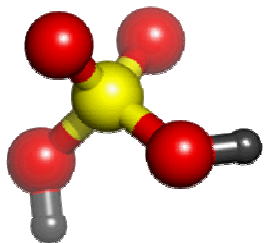


Review and design procedures

- ▶ Early consideration for inherent safety = high potential impact on process safety
- ▶ Hazard reviews
- ▶ Plant siting

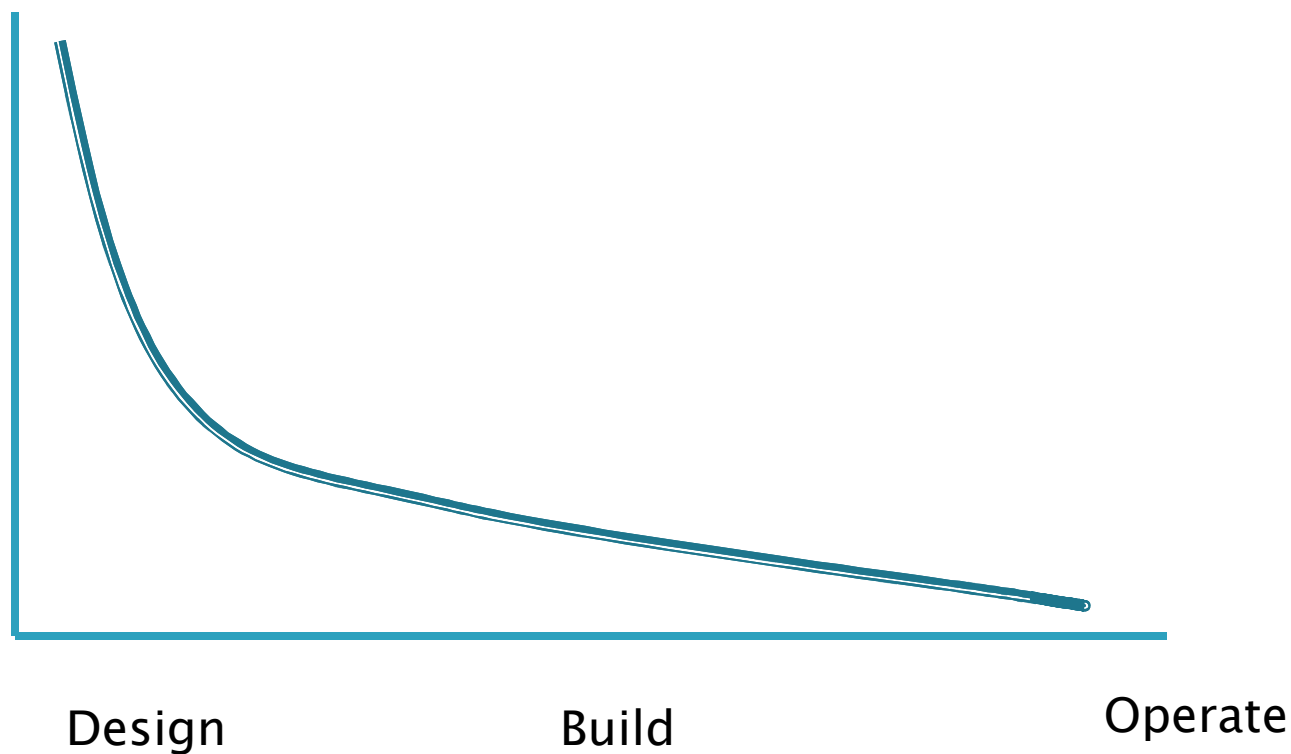
Management of change

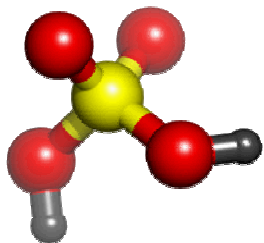
- ▶ Inherent safety involves change that must be managed
- ▶ Inherent safety opportunities when making process changes



Early consideration of ISD is important

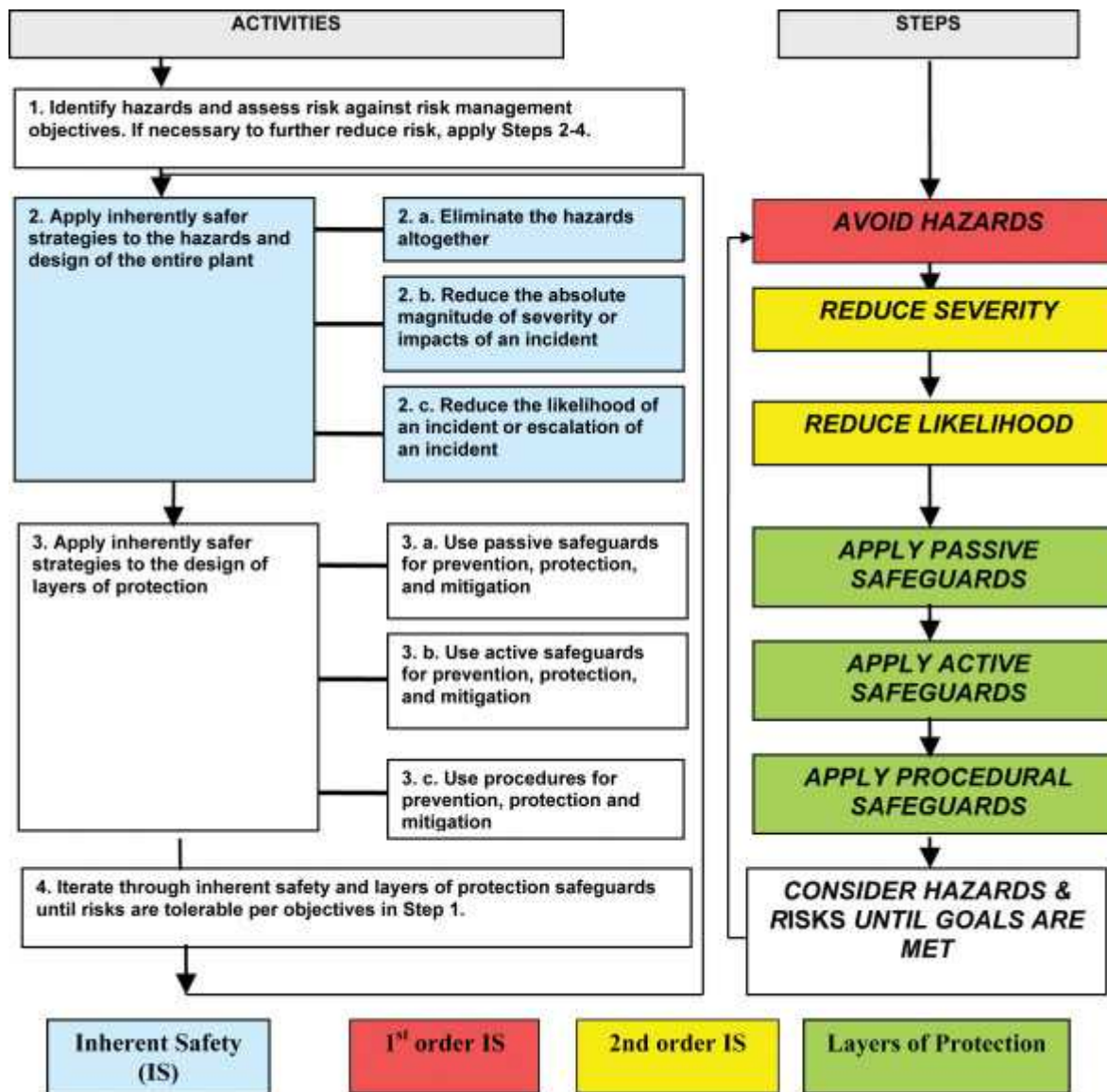
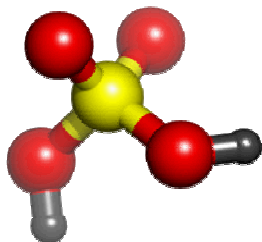
ISD
Opportunities



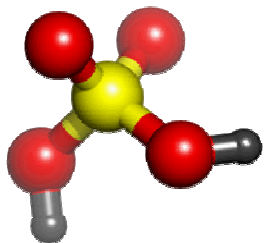


Design tools can be used to address inherent safety

- Dow Fire and Explosion Index
- Dow Chemical Exposure Index
- What-If analysis extended to What-If/Checklist analysis
- Use of IS-based checklists in identifying both hazards and additional risk reduction measures



Moore et al., Process Safety Progress (Vol.27, No.2) June 2008

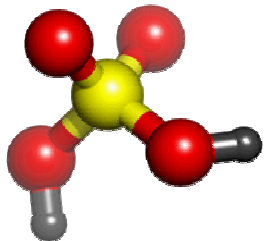


Inherent safety reviews

Most effective life cycle phases to review a process for opportunities to make it inherently safer (CCPS 2008a):

- R&D
- Conceptual design
- Detailed engineering
- Routine operation

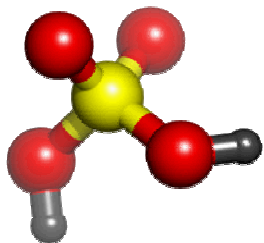
(Members of review team will vary depending on life cycle phase)



Inherent safety reviews

Typical inherent safety review steps (CCPS 2008a):

1. Collect and review background information
2. Identify / define / document the major hazards
3. Review the process flow schematic
 - Look at each process step and hazardous material
 - Identify creative ways to improve the process by applying inherently safer principles to reduce or eliminate hazards
4. Document the review and follow-up actions



Inherent safety reviews

Good resource for IS reviews (CCPS 2008a, Appendix. A4):
“An Inherently Safer Process Checklist”

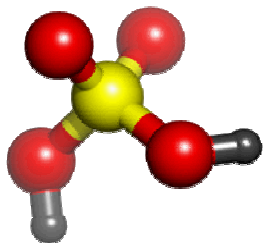
1 Intensification / Minimization

1.1 Do the following strategies reduce inventories of hazardous raw materials, intermediates, and/or finished products?

- Improved production scheduling
- Just-in-time deliveries
- Direct coupling of process elements
- Onsite generation and consumption

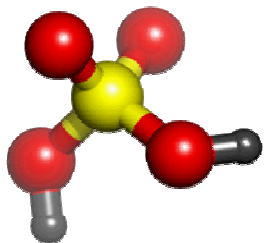
1.2 Do the following actions minimize in-process inventory?

- Eliminating or reducing the size of in-process storage vessels
- Designing processing equipment handling hazardous materials for the smallest feasible inventory
- Locating process equipment to minimize the length of hazardous material piping runs
- Reducing piping diameters



Caution: *Inherently Safer* does not necessarily mean lower risk!

- Process change may introduce new hazards
 - Examples
 - hydrogen gas generated by hydrolysis
 - the collection of vent discharge gases on carbon beds may create an explosion hazard
- Loss event likelihood may be affected
 - Example -supplying from many small cylinders instead of one large cylinder increases frequency of connecting and disconnecting cylinders
- Loss event severity can also be affected
 - Example -total containment increases burst pressure



Discussion: Volatile toxic liquid storage

Situation:

- Family 1 wanted one large storage tank,
- Family 2 wanted two smaller storage tanks.

Family 2 calculated that the worst-case impact is half as serious.

