

Hazard identification

3. Hazard and Operability: HAZOP

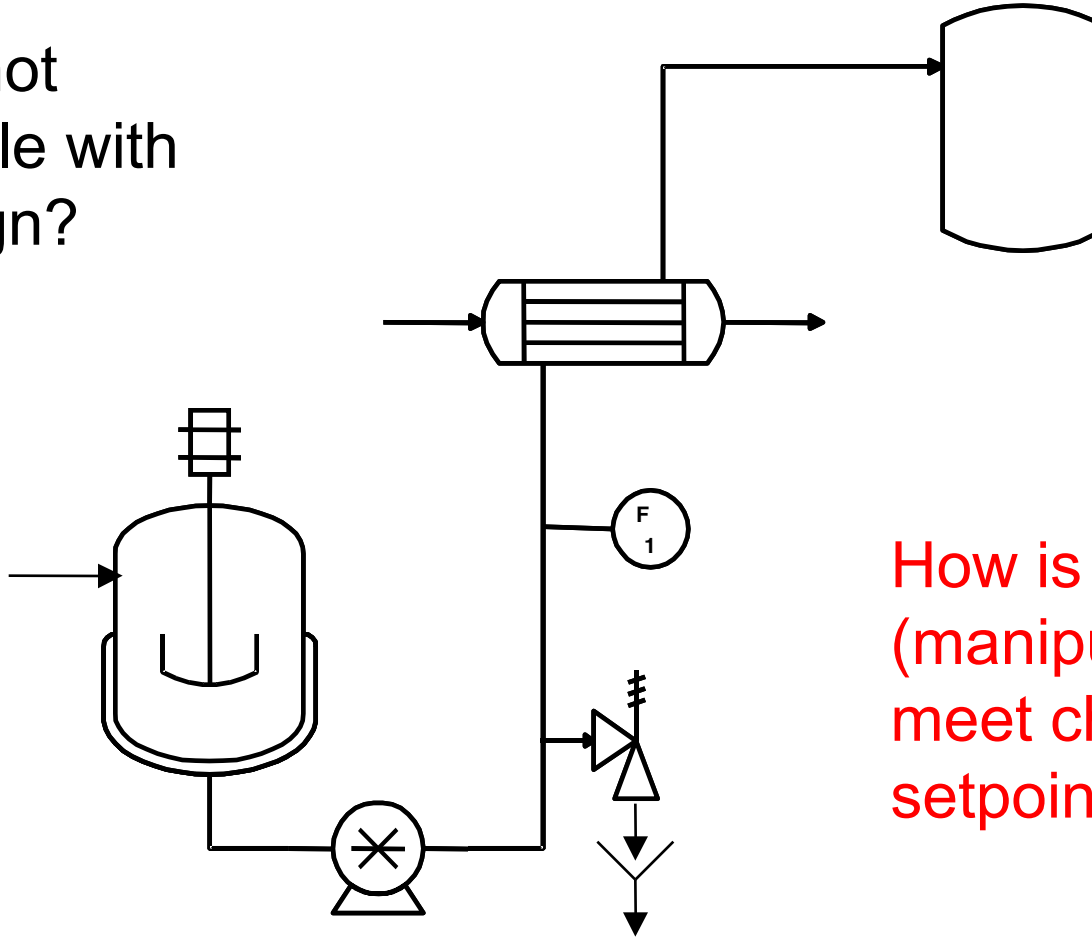
We have seen examples of safety – where is the “Operability”?

- When equipment fails, the likelihood of personal injury is high
- Identifying the cause of unsafe conditions, we can respond with improved equipment reliability, including maintenance
- Some parameter-guideword combinations will lead to conditions that are safe, but result in significant economic loss. These will require responses.

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What is not acceptable with this design?

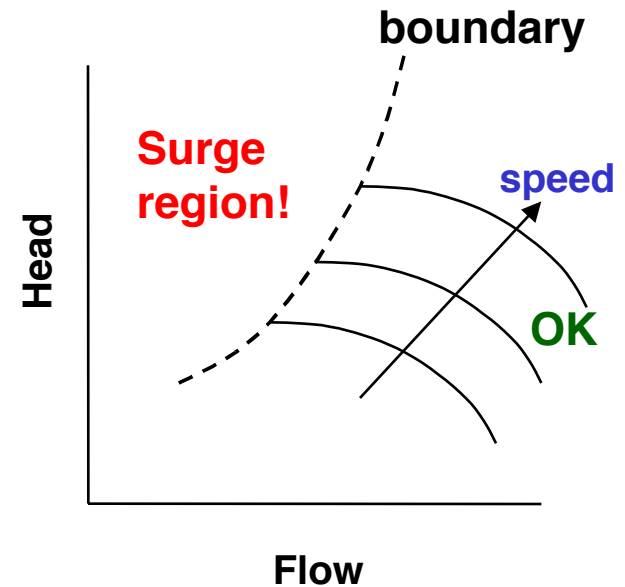
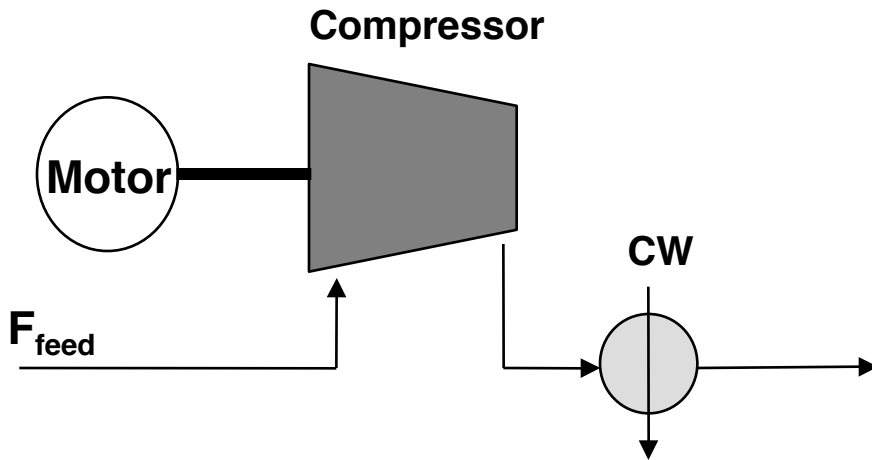


Constant speed
PD pump

How is flow adjusted
(manipulated to
meet changing
setpoints?)

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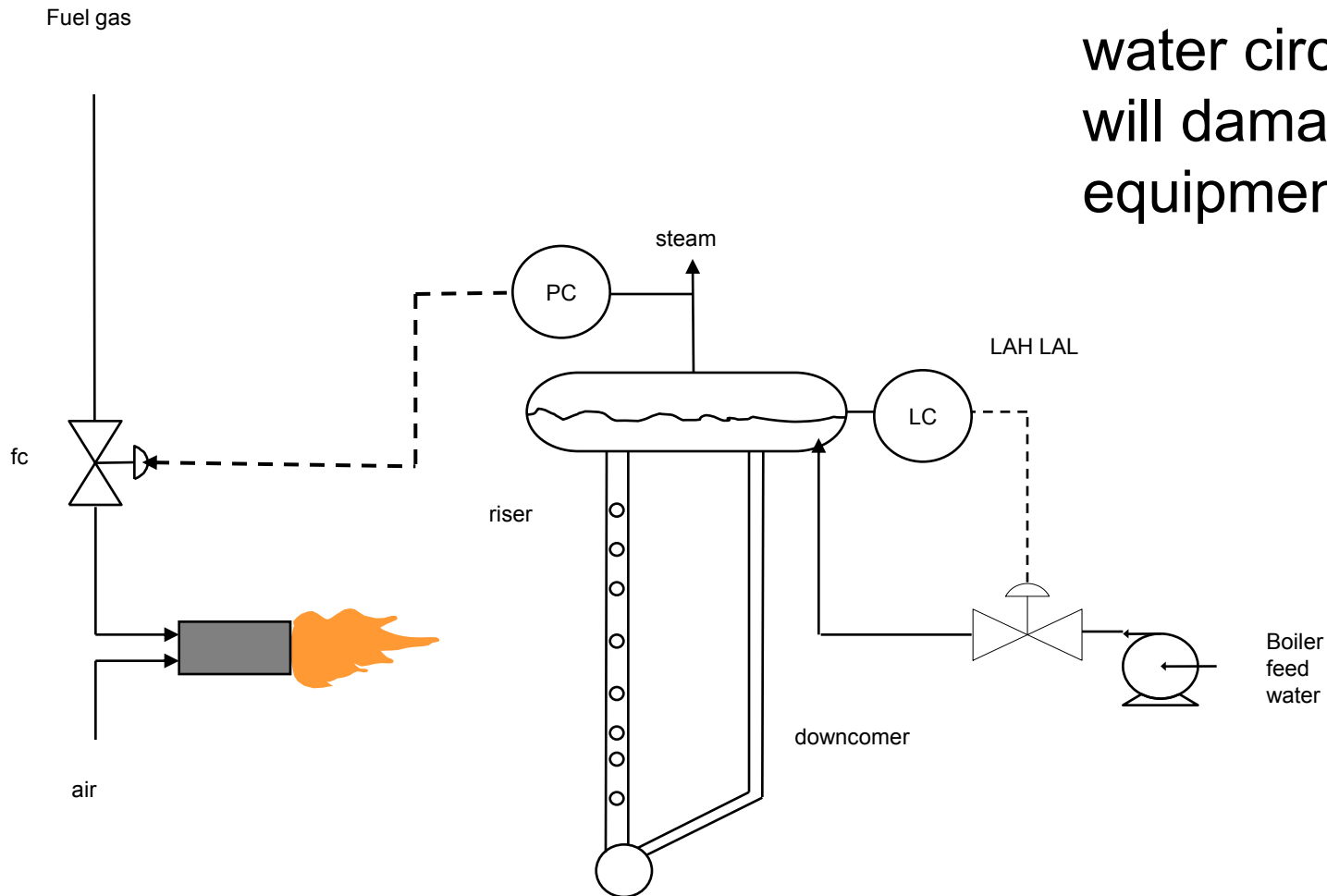


Exceeding the operating window of the equipment could lead to unsafe conditions.

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Continuing fuel combustion w/o water circulation will damage equipment



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HAZOP - Process applications

- Thorough review at or near the completion of a new process design
 - Equipment and operating details known
 - Can uncover major process changes
- Review of existing processes (periodic update)
 - Safe operation for years does not indicate that no Hazards exist
- Review of changes to an existing process that had been “HAZOPed” - Important part of **Change Management**
 - No consistency on what type of changes require formal HAZOP

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Managing the HAZOP process

- The HAZOP group should contain people with different skills and knowledge
 - operations, design, equipment, maintenance, quality control, ..
 - do not forget operators!!!
- The team should understand the plant well
- Documents should be prepared and distributed before the meeting
- The HAZOP leader should be expert in the HAZOP process
- Results must be recorded and retained

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- At the conclusion, every item should be evaluated for further study
 - the need for and priority of future effort is decided
 - every item should be evaluated for
 - + severity,
 - + likelihood, and
 - + cost (H/M/L or weightings 1-10)
 - columns for the three factors above can be added to the standard HAZOP form (See Wells, 1996, p. 104-5)
- For all significant items, a Hazard Assessment is performed (one or more of methods below)
 - Fault Tree
 - Event Tree
 - FMEA (failure mode and effects analysis)
 - Consequence Analysis
 - Human Error Analysis

Hazard identification

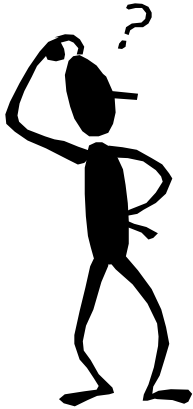
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HAZOP - Some words of caution

- Recommendations are based on (likelihood x consequence x action cost)
 - Do not "gold plate" the plant for very unlikely scenarios
 - airplane hitting a plant is very unlikely; however, a nuclear power plant has large consequence
- Very complex systems are prone to failure, this includes safety systems
 - remember about alarm proliferation ("crying wolf") - this can happen with other aspects of safety

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You are responsible for the safety team.

Without HAZOP

How will you document that you have performed and implemented a professional safety study?

Without HAZOP

How will you focus all members of a team on the key issues in a systematic manner?

REFERENCES

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AIChE, Guidelines for Engineering Design for Process Safety, American Institute of Chemical Engineers, New York, 1993

AIChE, Guidelines for Consequence Analysis of Chemical Processes, American Institute of Chemical Engineers, New York, 1999

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Wells, G., Hazard Identification and Risk Assessment, Institute of Chemical Engineers, Gulf Publishing, Houston, 1996 (ISBN 0-85295-353-4)

Some WEB sites

<http://slp.icheme.org/chemicals.html> (safety-related data bases)

<http://tis.eh.doe.gov/techstds/standard/hdbk1100/hdbk1100.pdf> - USA DOE Safety Handbook

www.lihoutech.com/hzp1frm.htm - About one chapter on HAZOP from company that provides HAZOP software

<http://ed.icheme.org/chemengs.html> - Good source of general information on chemical engineering, follow key words for safety and risk. By IChemE in the UK