GUIDING THE WAY

Matthias Schopf and Joshua Baptist, Eastman Chemical Co., outline how the Strictly Closed Controlled Systems guidelines are vital in mitigating the risks associated with the use of heat transfer fluids in industrial processes.

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Heat transfer fluids (HTF) have been used alongside industrial processes for as long as industrial processes have existed. The first HTF systems were rudimentary and used water as the HTF. These heat transfer systems were limited to a narrow application field such as engines and heaters. Over time, technology, products, processes, regulatory requirements, and HTFs all received improvements to efficiency and safety at the benefit of heat transfer systems. Due to these improvements, HTFs and HTF systems are now used in a variety of applications and industries, including chemical processing, oil and gas, pharmaceutical manufacturing, and clean energy production.[1]

As heat transfer use has become ubiquitous throughout industry, the varying system design concerns have largely remained the same. For instance, an optimally designed heat transfer system is of a welded construction and includes an expansion vessel covered by inert gas.[2] However, despite these similarities across the different industry sectors, regulatory and safety concerns can interject complexity through the hazardous operating conditions that are presented by a heat transfer system. These conditions could include high operating temperatures, pressurised lines, physical and chemical properties stemming from the manufactured products or resources, and the raw materials required to operate the system. These hazards may present risks to human health or the environment, which makes it critical that operators take steps to minimise these associated operational risks.[3] There have been several standards and guidance documents published to help mitigate these risks. Recently, regulators in the EU have worked to assemble the most meaningful and effective of these publications into a technical guidance document known as Strictly Closed Controlled Systems (SCCS).

The European Chemicals Agency (ECHA), whilst operating under the REACH regulation's restriction proposal process, has recently proposed the SCCS as a regulatory measure to allow the continued use of critical chemistries in the EU while also limiting their potential releases and exposure.[4,5] The SCCS provides specific industry standards for operators to follow, as well as a summary checklist of what to review on a HTF system. The checklist is divided into eight sections (A to H). Each section handles specific elements of the HTF system, and it has targeted questions to help evaluate compliance under the SCCS guidelines.

Section A: installation and equipment

This section informs how a HTF system is installed, even including which equipment might be used. It helps operators to answer the following questions:

- Is the system installed on an impermeable surface, and are potential leakages diverted to a safe location to avoid emissions into the environment?

- Is the build quality of the system appropriate? How many flanges and valves are reasonable given the systems design and purpose? What type of pump is most appropriate?
- How and where should sampling occur on the system? What control and safety equipment are required to maximise safety?

Section B: filling, start-up, shutdown and drain

This section deals with specific aspects of filling the HTF system, operating instructions for start-up and shut-downs, leakage detection during tasks, and which staff are qualified to perform these tasks.

Section C: operation of the heat transfer system

Section C provides details on process safety control measures for pressure, flow, and temperature. It also covers the need for a hard copy operating manual that is accessible by staff and emergency personnel.

Figure 1. Secondary circuit pumps.

Figure 2. Expansion vessel.

Section D and E: maintenance of the heat transfer system

This section details how to inspect the maintenance procedures of a system. Procedures covering results of leakage testing, regular sample analysis, and top-up methods are addressed.

Section F: dismantling/decommissioning and waste disposal

Section F covers how to review procedures for handling degraded HTFs, spills, transport, and disposal.

Section G: training

This section instructs the operator how to evaluate the existing training plans of a facility. This is to ensure that every employee and contractor is aware of the requirements for safe operation of their HTF system.

Section H: inspection

The final section reviews internal and external inspection routines and how they are performed.

Interview

Given the broad application of the SCCS guidance, it is informative to see how industry is using it in a day-to-day scenario. A well-known Italian manufacturer of plastics and chemicals has shared their experience and system details in a Q&A below. For this example, the manufacturer was willing to answer questions about how its system fits into Section A of the SCCS checklist. The following information and Q&A session was between an Eastman subject matter expert and the manufacturer's Engineering & Technology Manager.

This manufacturer's production system uses Therminol®66 as its HTF at an operational temperature of approximately 335°C.

Q: Is the whole HTF system installed on concrete or equivalent non-permeable ground? If not, what measures are in place to prevent HTF leaking into the environment?

A: Equipment like vessels, pumps, and heat exchangers are installed on concrete floor or pavement. Some part of the piping, including a limited number of manual valves and instruments, are situated in areas covered with an impermeable sheet or asphalt to capture incidental leaks.

Q: Is the system designed in such a way that it diverts leaks to safe release areas?

A: Equipment like vessels, pumps, and heat exchangers are installed on concrete floor or pavement, which is drained to a concrete fire retention pit. This pit is sized to receive water from the fire extinguishing system as well as any incidentally released HTF.

Q: Are vessels and tanks equipped with expansion lines or vents? And are those vents/lines routed into a collection location?

A: High points of the circuit are vented to the expansion vessel. The expansion vessel is equipped with a low boiler separation system. Only incondensable fluids are routed to a storage vessel.

Q: Are there stop valves in the HTF feed and return pipes? Has their suitability been proofed (either by manufacturer tests or expert)?

A: The HTF circuit has manual valves. Only high-quality globe valves from proven vendors are used. Valves are equipped with a bellow seal and have weld ends.

Q: What type of installed pumps (magnetically driven, canned motor, double seals, liquid barrier, etc.) are used? Are the pump housings designed for up to 16 bar pressure?

A: Installed circulation pumps are equipped with double mechanical seal or single mechanical seal with quench. Pump housings are PN25 or PN16 rated.

Figure 3. Expansion vessel inert gas.

Figure 4. Primary circuit pumps.

Q: Will any leaks from the pumps be contained?

A: Pumps are installed on concrete floor or pavement which is drained to a concrete fire retention pit or installed above a concrete basin to ensure containment of any leaks.

Q: Is the equipment for sampling points designed to contain leakages?

A: Yes, sampling points are equipped with a double manual valve and blind flange to minimise leak potential.

Q: Are there control equipment and safety devices in place to ensure the safety of the system and the process (e.g. temperature and pressure controls, flow meters etc.)?

A: HTF furnaces are equipped with several safeguarding instruments. These instruments can safely shut down a system if there is minimum HTF flow (pressure drop), the system gets too hot, and if the pressure gets too high. In scenarios where it is needed, pressure relief valves are routed to a HTF storage vessel.

Conclusion

As can be demonstrated through a walkthrough of Section A of the SCCS checklist, achieving the target of a highly efficient, but also safe and responsible process, can be done by ensuring that the system design and construction, the operation and maintenance procedures, and inspection is at the guidance level detailed by SCCS.

The concept of operating a strictly controlled closed HTF system has been realised in the industrial space for some time. The SCCS pulls together several national standards, insurance guidance papers, and European regulations to help industry have a standardised approach. The concept of SCCS, and especially the checklist, provides an excellent guidance for system designers and downstream users to evaluate the effectiveness of their design and maintenance. This is all done to achieve the target of minimising the human and environmental health risk associated with the operation of any HTF system.

Disclaimer

References

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