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Cause Evaluation

Customer: United Illuminating Company (UI) Location: Amity High School, Woodbridge, CT Date: 9/21/2017
Unit: MM21 Model: DFC3000B3 Record #: CSR-0010-D

PROBLEM STATEMENT:

Pressure relief valve on the Heat Recovery Unit (HRU) propylene glycol loop actuated, releasing propylene glycol/water mixture at the site.

EVENT DESCRIPTION:

On Thursday July 20, 2017 at approximately 8:20 AM ET, the fuel cell power plant was manually taken offline and power disconnected to facilitate planned maintenance work on the Woodbridge microgrid. Upon completion, operators restarted the plant at approximately 4:10 PM ET. At approximately 7:00AM on July 21, 2017, the Global Monitoring and Control Center (GMCC) was notified by UI (Jim Bertini) of a leak from the power plant. Service personnel arrived onsite, observed a propylene glycol/water discharge on the ground. The power plant was subsequently shutdown at 8:04 AM ET to perform further inspection and respond to the release.

The selection of propylene glycol as the heat transfer media was selected, in part, due to its non-toxic nature. The Food and Drug Administration (FDA) has classified propylene glycol as an additive that is "generally recognized as safe" for use in food. Refer to CSR-0011 Environmental Incident Summary for additional details.

APPARENT CAUSE(S):

This investigation used the "Why Staircase" method.

1) WHY WAS THE PLANT SHUTDOWN?
A FCE operator manually shutdown the plant because a propylene glycol/water mixture was found on the ground. The power plant was shut down to perform further inspection and respond to the release.

2) WHY WAS A POLYPROPYLENE GLYCOL/MIXTURE FOUND ON THE GROUND?
The propylene glycol/mixture was found on the ground because the pressure relief valve on the system actuated.

3) WHY DID THE PRESSURE RELEIF VALVE ACTUATE?
The pressure relief valve actuated because the actual system pressure exceeded the valve actuation set point.

4) WHY DID THE ACTUAL SYSTEM PRESSURE EXCEEDED THE VALVE ACTUATION SETPOINT?
The amount of heat entering the system was not controlled effectively resulting in the fluid expanding, increasing the pressure in the system beyond the pressure relief valve actuation set point. **[Apparent Cause (AC) – Equipment/Material Problem – A2]**

5) WHY WAS THE HEAT ENTERING THE SYSTEM NOT CONTROLLED EFFECTIVELY?
The fuel cell power plant exhaust flow damper failed in-place and was unable to modulate for controlling the heat entering the system. **[Cause – Damaged, defective or failed part – A2B6C01]**

In summary, the plant protection systems operated as expected and the cause of the propylene glycol/water mixture on the ground was due to a failed exhaust flow damper.

EXTENT OF CONDITION (EOC):

In this plant, there are no other exhaust flow dampers and therefore no potential for the same condition to occur elsewhere. United Illuminating has two other DFC3000B3 plants and UIL Distributed Resources has one DFC3000B3-ERG plant. They are Seaside Park, CT (MM19), New Haven, CT (MM20), and Glastonbury, CT (MM22-ERG). MM19 and MM20 do not have HRU's. MM22-ERG has a HRU and therefore a potential for actuation of relief valve(s), but the relief valve(s) are piped to Relief Valve Catch Drum(s) thus not allowing the propylene glycol/water mixture to spill to the ground. Additionally, a level transmitter on

each drum alarms the operators of an actuated relief valve. Upon evaluation of the remaining FCE operating fleet in Connecticut, it was identified that one non-UI owned plant also has the potential for this condition.

ACTIONS COMPLETED:

ISSUE	ACTION(S) COMPLETED
EOC – MM22-ERG has a HRU with the potential for the same condition	For the DFC3000B3-ERG product at Glastonbury, the Piping and Instrument Diagram was reviewed for the propylene glycol loop to determine if the fuel cell exhaust flow damper failed, actuating the pressure relief valve, would a propylene glycol / mixture be discharged to the ground. This condition cannot occur on MM22-ERG due to product design differences from the DFC3000B3.
Apparent Cause (AC) – Equipment/Material Problem – A2	Work Order 027165 isolated and drained the HRU system to facilitate repair. Also under this work order, a cleanup contractor came and cleaned the propylene glycol/water mixture from the ground. The fuel cell power plant went back into service (heat up) at 5:58 PM on July 21, 2017, leaving the HRU system out of service.

CORRECTIVE ACTIONS:

ISSUE	CORRECTIVE ACTION DESCRIPTION
Cause – Damaged, defective or failed part – A2B6C01	Work Order 027394 was generated to repair the fuel cell power plant exhaust flow damper. FuelCell Energy engineering and service departments will determine a restoration plan for HRU operation while the plant continues to operate in electrical generation mode without heat recovery. Work Order 027404 was generated to inspect and repair the Amity High School HRU System.

PREVENTIVE ACTIONS:

A power plant protection system upgrade for a HRU propylene glycol loop high temperature shut down will minimize the potential for a high temperature induced actuation of the pressure relief valve. A relief valve containment system with alarms to be added for glycol overflow, such as already exists at Glastonbury, to this unit and the non-UI owned site. SDS (Safety Data Sheets) will be available on site at the Fuel Cell and provided to stakeholders.

ADDITIONAL ACTIONS:

The event highlighted an opportunity to provide additional project awareness and event response actions to local stakeholders. Based on this, there are two additional actions.

1. Awareness Outreach Effort for Amity High School, the Town of Woodbridge, and the Woodbridge Fire Department

   The Awareness Outreach Effort encompasses the following:

   - Project Description (equipment and what it does)
   - Summary of Operations and Maintenance Service including Response Time
   - Hazardous / Non-Hazardous Materials
   - Process for Reporting a Problem
2. Post an emergency contact placard at the fuel cell. The Woodbridge Fire Department attempted to

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contact the GMCC prior to the 7:00AM call on July 21, 2017. The emergency contact information they had contained local and 800 numbers. They attempted to contact the GMCC using the local number, which is an internal number within FuelCell Energy and does not accept outside calls. This incorrect information was in training materials provided by FCE during the startup of the unit and has been corrected for all future training materials. A placard with the GMCC 800 number will be posted at the fuel cell to facilitate direct contact with the GMCC and facilitate faster response. Work Order 028291was generated to install the placard at this site. Work orders were also generated to ensure placards exist at all fuel cell installations.

[END OF REPORT]