SulfaTreat Vessel at Lincoln Storage Field

Background

The Lincoln Storage Field is an aquifer storage field in the Silurian Niagaran Reef that was developed by Central Illinois Light Company. The field was placed in operation in 1974. Almost from inception, it was evident that gas injected into the reservoir and ultimately withdrawn from storage would be contaminated with hydrogen sulfide (H2S). In order to assure the gas removed from storage and delivered to its customers was pipeline quality, it was necessary to install hydrogen sulfide removal facilities. Stretford system U-101, an un-housed hydrogen sulfide treating facility, was installed in 1971 during the initial development of the field. During early operation, CILCO engineers determined that increases in daily withdrawal deliverability necessitated the installation of a second Stretford Plant (U-201) which became the primary purification unit after its installation in 1978. The new plant was enclosed in a building. Following the installation on Unit U-201, Unit U-101 was used as a supplement to Unit U-201 or when flow rates exceeding approximately 50 MMCF/D. In 1981, hydrogen sulfide concentrations from the reservoir ranged between 15 PPM during early in withdrawals to highs of 115 PPM late in the withdrawal season. The significant increase can be attributed to the fact that early in withdrawal, gas initially withdrawn from Lincoln had been in the reservoir for the shortest time and is farther from aquifer contact. Consequently, this gas showed lower hydrogen sulfide concentrations (+/-15 PPM). Later in withdrawal, the gas bubble decreased in size and gas withdrawn comes from an area that is closer to the aquifer contact. This gas proves to be significantly higher in hydrogen sulfide concentration (100-115 PPM). H2S increases by the act of lowering the aquifer pressure below that of

the original aquifer pressure. This allows the dissolution of H2S from the aquifer. There is a continuous threat that the gas stored in this carbonate reservoir can generate hydrogen sulfide concentrations in the 100 PPM range or greater. It is required and prudent from an operational standpoint for adequate hydrogen sulfide removal equipment to be available at Lincoln to handle higher concentrations of H2S during periods of peak flow late in the withdrawal season when performance is critical and drawdown is higher. It is important to point out that when units U-101 and U-201 were installed (1971 and 1978) the SulfaTreat process was not yet commercially available. The first commercial application of the SulfaTreat process occurred on September 25, 1989.

The Stretford Plants adequately remove sulfur from the reservoir, but, over time, they have proved to be more inefficient than other processes, operationally difficult to maintain, as well as posing some health hazards to operations personnel. A decision was made in 1993 to install SulfaTreat vessel 11V1 to insure hydrogen sulfide removal and to compensate for operational inefficiencies associated with both units U-101 and U-201. By late 1998, Unit U-101 had reached its life expectancy and was removed from service. SulfaTreat vessels 12V1 and 13V1 were installed in late 1998 utilizing Unit U-101's foundation. At this time, SulfaTreat vessels 12V1 and 13V1 were being used as the primary vehicles used for the purification of gas. SulfaTreat vessel 11V1 remained as a polishing unit for Stretford Plant Unit U-201. SulfaTreat vessel 14V-1 will provide additional gas polishing capability to cover the increased peaking capability at the Lincoln Storage Field at a lower pressure differential across the plant.

AmerenCILCO increased its peak day deliverability capabilities at Lincoln as follows as the result of drilling a Horizontal well and remedial well work:

1) 45 MMCF/D to 55 MMCF/D for the 1998/1999 withdrawal season
2) 55 MMCF/D to 65 MMCF/D for the 2001/2002 withdrawal season
3) 65 MMCF/D to 70 MMCF/D for the 2003/2004 withdrawal season

Discussion

Prudent measures to ensure the reliable purification of the gas withdrawn from storage to support the increased flow rates are required. Under the current configuration any down time for one of the SulfaTreat vessels would result in decreased delivery of expected withdrawals from storage. At a hydrogen sulfide concentration of 40 PPM, running all three vessels in parallel (11V1, 12V1, and 13V1) allows throughput of 27 MMCF/D per vessel, or 81 MMCF/D with a 4.75 psig differential. This allows for treatment of the current peak day flow. However, if higher concentrations of H2S were experienced as in the past, or should one vessel become contaminated, hydrated off or lost due to other operational issues, peak day deliverability would not be achievable.

Parallel flow of the SulfaTreat vessels involves using all three vessels simultaneously and allowing gas flow through at the same time processing three different flow streams. Gas only passes through a vessel once. Yet, prudent and recommended operation in a lead lag scenario achieves optimum media life of the SulfaTreat chemical. A lead-lag scenario involves flowing of gas through one vessel and into a second vessel for polishing. This allows for the total depletion of media in the lead vessel. This can also increase the bed life by approximately 30%. At an estimated $70,000 a year to change out of the media results in savings estimated to be $23,000/year.

At 40 PPM hydrogen sulfide concentration, the lead-lag arrangement of two vessels allows for a maximum 52 MMCF/D gas flow rate at a 22.49 psig differential. The difference in pressure drop associated with the lead-lag arrangements is significant

and needs to be taken into consideration during peak flow periods, especially during the end of the withdrawal season. . In other words the lead – lag configuration maximizes bed utilization, hence reduces operating cost, but it cannot supply peak day requirements whereas parallel configuration allows peak day deliverability but does not maximize bed utilization, hence increasing operating cost. The addition of the fourth tower allows operation in either configuration. Lead lag configuration or parallel configuration for the towers can be achieved by opening or closing the appropriate valves. The lead lag configuration allows for a much simpler operation of the H2S purification process.

It must be further pointed out that this situation is only exacerbated by an increase in the field hydrogen sulfide levels. There is always a real threat of this occurring as it has in the past, which further reinforces the need for a fourth vessel. These reasons strengthen the need for the addition of a 4th SulfaTreat vessel at Lincoln Storage Field.

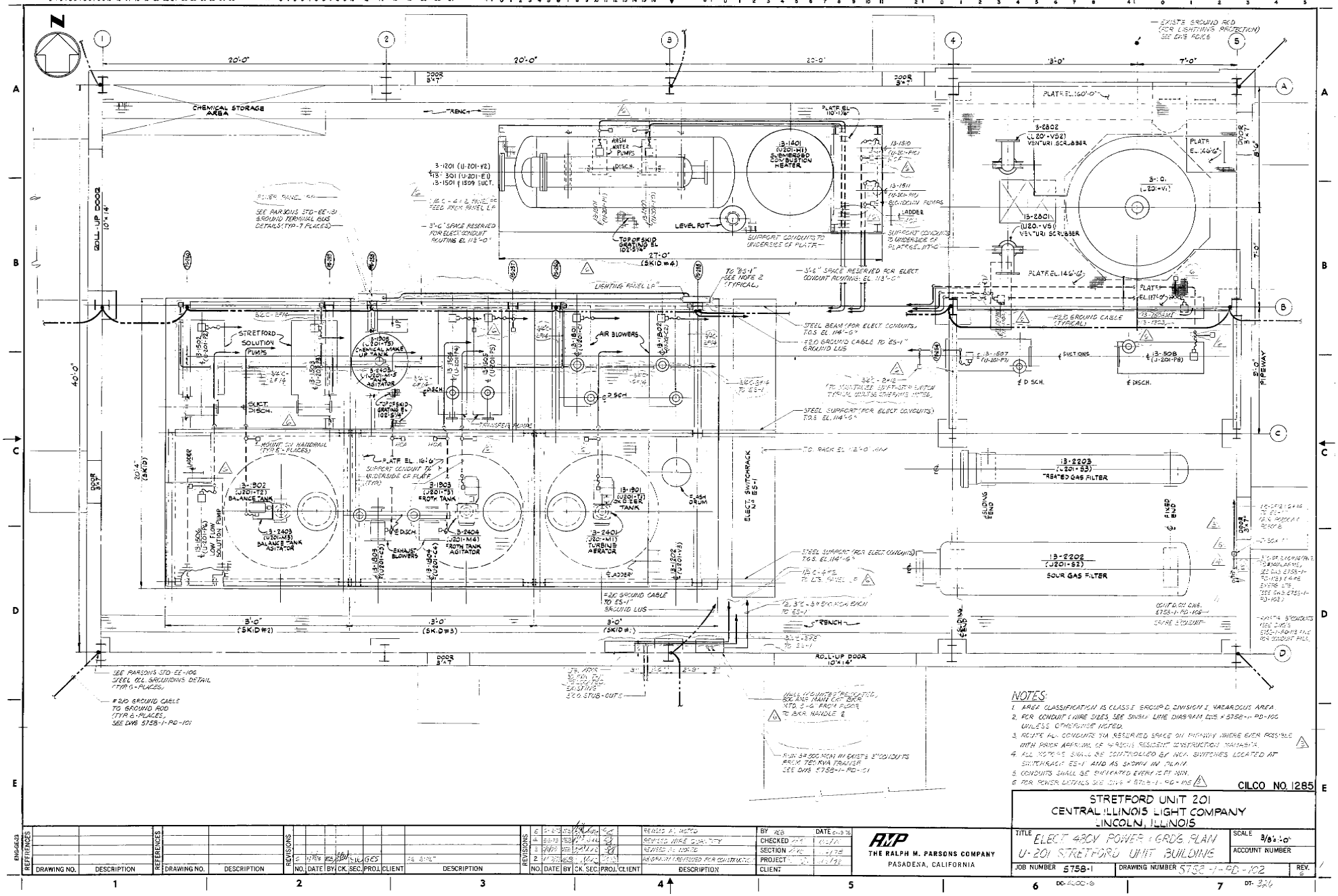
It should be noted that this project was evaluated in the ISP tool that Ameren utilizes to prioritize projects and make decisions which projects to fund. This project made the list for projects to proceed with.

Benefits

1) During power outages, flow rates are not restricted across the SulfaTreat vessels as the vessels do not require support equipment operated by electricity. As the equipment in the Stretford plant requires commercial electricity to operate above

flow rates of 250 MSCF/H, the plant becomes virtually useless during power outages.

2) Significantly lower differential pressure across the SulfaTreat vessels during treatment of gas permit higher flow rates at lower inventories and pressures. This is critical later in the withdrawal season when typically higher flows are needed to meet demand. Differential pressure across the Stretford plant was a minimum of 50 psig compared to a differential pressure drop across the SulfaTreat vessels of 10 – 13 psig.
3) Achieve optimum media life occurs in a lead-lag scenario, $23,000/yr.
4) Avoided known capital expenditures of $189,000. ENG 1.10 Attach 2.
5) Avoid known annual O&M expenditures $97, 849/yr. ENG 1.10 Attach 1
6) Safety and health considerations associated with the operation of Unit U-201, include the handling of hazardous chemicals sodium vanadate and Anthraquinone disulfonic acid during mixing of the Stretford solution.
7) To keep the Stretford unit another operator would have to be added to address the ongoing maintenance requirements of the unit. This would lead to an additional annual cost of $110,000 ($107,000 loaded annual base cost plus $3,000 of expected overtime). See Ameren Exhibit 47.6.
8) If one SulfaTreat vessel becomes contaminated, hydrated off or lost due to other operational issues; peak day deliverability would not be achievable under the current configuration.

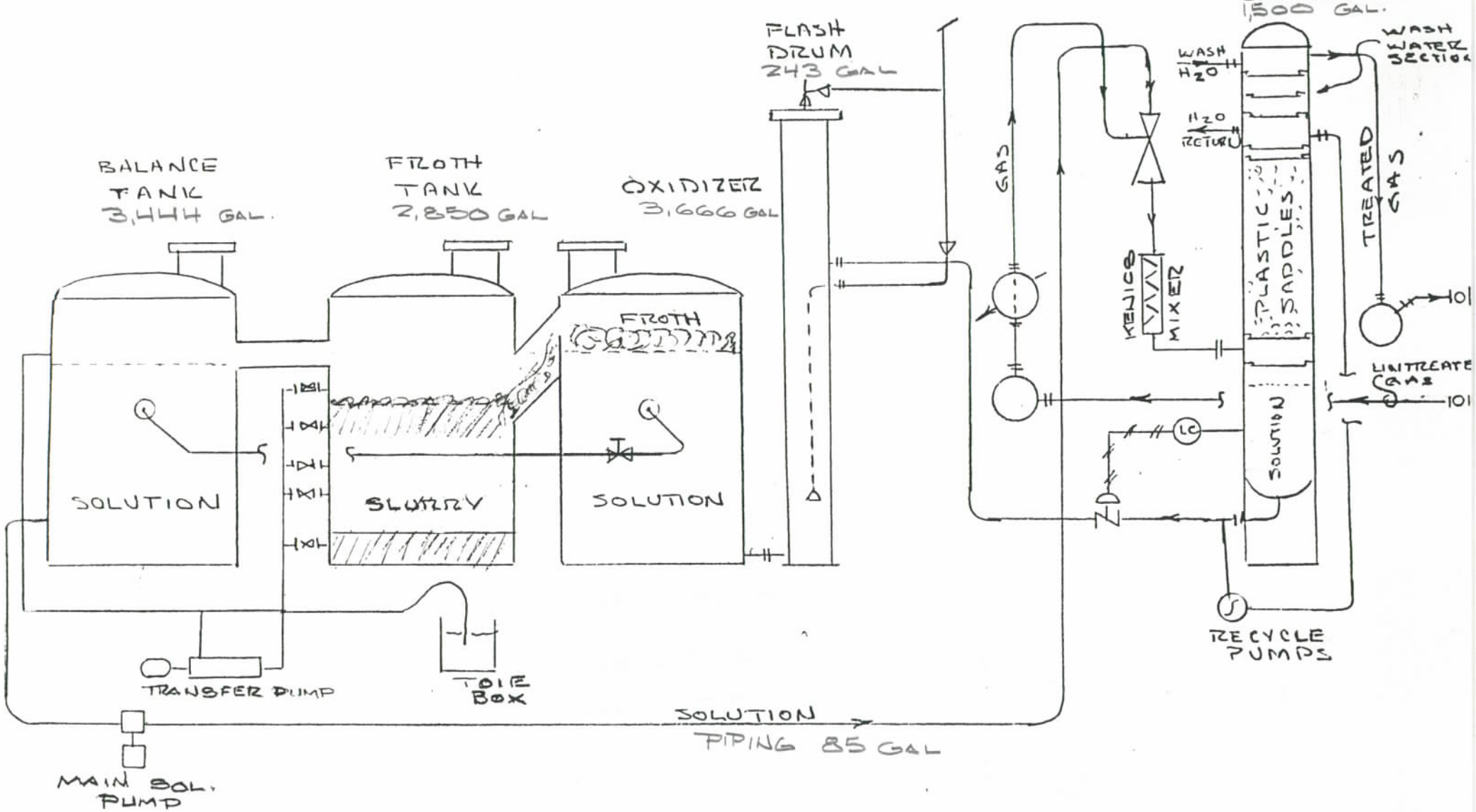


Ameren Exhibit 47.2

Ameren Exhibit 47.3

SULPHLIZ PROCESSING SECTION

STRETFORD U-201



TOTAL GAL. 11,788