



CONTROL NARRATIVE

Ammonia Tank Farm

Aqueous Ammonia Truck Unloading, Storage Tanks, Forwarding, Vaporizer & Dilution Air Package



ABOVE: Exmple of an Ammonia Tank Farm built by IFS.

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Sandy Creek Project

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Revision:	Date:	Purpose:
0	04/13/09	Approved For Construction
1	05/13/09	Revised Per Customer Comments
2	06/29/09	Revised Per Customer Comments
3	11/24/09	Revised Per Customer Comments

TRUCK UNLOADING STATION:

Truck Unloading Control Panel [CPL-604] (Located Off Skid-Outside Of The Hazardous Location):

- available to fill amber pilot light per tank (DO)
- tank start filling illuminated-push button per tank (DO/DI)
- tank stop filling illuminated-push button per tank (DO/DI)
- unloading skid open/closed pilot lights (DO)
- six (6) channel ammonia detector-truck unloading station and ammonia tank farm monitoring (DI)
- limit switch (DI)
- pneumatic actuated valve-ABV (DO)
- tank liquid level (AI)
- tank pressure (AI)

Operation:

1. Visually inspect that the vapor return and liquid fill lines are properly connected to the truck.
2. The DCS operator selects the tank TNK-005A/B to be filled. The farm tanks that are available for filling can be identified with an amber pilot light located on the front of the truck unloading station control panel [CPL-604]. When the tank TNK-005A/B is available for filling, the amber pilot light will be illuminated.
3. In order to begin filling a tank TNK-005A/B the liquid level of the tank (LT-509 or LT-514) must be < 85%, the pressure inside of the tank (PT-505 or PT-510) must be < 50 psig, and no ammonia should be detected at the truck unloading station or inside of the tank farm, and no Ammonia Controller Fault should exist and Tank Discharge Valve (ABV-139 or ABV-141) must be closed. If any of the above conditions are not met during operation, the station/package will automatically shutdown.
4. Select the tank TNK-005A/B to receive ammonia by pressing the respective tank start filling push button located on the front of the truck unloading station control panel CPL-604.
 - 4a. The operator should first manually open the vapor return line (BV-101) at the truck unloading station. Then the liquid fill line (BV-102) should be manually opened by the operator.
 - 4b. When it has been determined that both the manual vapor return (BV-101) and liquid fill (BV-102) lines have been opened at the truck unloading station (via the indication lights on the local panel CPL-604), the operator shall press the selected tank's fill push button. The selected tank vapor return (ABV-118/120) will be commanded to open and verified (via limit switch).
 - 4c. Verification that the tank vapor return (ABV-118/120) has opened (via limit switch) will initiate the command to open the selected tank liquid fill (ABV-114/116) and verified (via limit switch). At this point the selected tank (TNK-005A/B) can be filled and associated tank filling amber pilot light flashes.
 - 4d. The operator can begin pumping liquid from the truck to the tank (TNK-005A/B).
5. In order to stop filling a tank (TNK-005A/B), the operator should stop pumping liquid from the truck (TNK-005A/B).
 - 5a. After the truck pump has stopped pumping liquid to the selected tank (TNK-005A/B), the operator should press the respective tank stop filling push button located on the front of the truck unloading station control panel (CPL-604).
 - 5b. When the stop filling push button has been pressed, the selected tank liquid fill ABV (ABV-114 or ABV-116) will be commanded to close.
 - 5c. Verification that the tank liquid fill ABV (ABV-114/116) has closed (via limit switch) will initiate the command to close the tank vapor return ABV (ABV-118 or ABV-120).

5d. Verification that the tank vapor return ABV (ABV-118 or ABV-120) has closed (via limit switch) will illuminate the tank stop filling pilot light, turn off the tank start filling pilot light, and the tank filling amber pilot light stops flashing.

6. The operator should manually close the liquid fill line (BV-102) at the truck unloading station. Then the vapor return line (BV-101) should be manually closed by the operator. Verification that both valves are closed can be seen with the valve closed pilot light on the control panel.
7. The operator can disconnect liquid fill and vapor return lines from the truck unloading station.

Automatic Shutdowns:

1. Selected tank level (LT-509/514) is $>$ or $=$ 85% (This condition will turn off the selected tank available to fill pilot light and will not allow this tank to be filled until the level is again $<$ 85% and the alarm has been reset.)
2. Selected tank pressure (PT-505/510) is $>$ or $=$ 50 psig (This condition will not allow this tank to be filled until the pressure is again $<$ 50 psig and the alarm has been reset.)
3. Ammonia detection at the truck unloading station or the tank area (This condition will not allow any tank to be filled until there is no more ammonia detected and the alarm has been reset.)

AMMONIA FORWARDING SKID PACKAGE

Forwarding Junction Box [JBX-601](Located On Skid-Outside Of The Hazardous Location): - forwarding pump outlet pressure (AI)

Operation:

1. In order to begin pumping from a tank, the liquid level of the tank (LT-509 or LT-514) must be $>$ or $=$ 5%, the pressure inside of the tank (PT-505 or PT-510) must be less than negative 3 psig, the vaporizer level (LT-528) should be $<$ 95 % and there should be no ammonia detected at the tank area or at the vaporizer package area. If any of the above conditions are not met during operation, the station/package will automatically shutdown.
2. The operator must verify that the manual valves (BV-138, BV-140, BV-150, and BV-151) for the pump train intended for operation are open.
3. Select (via the DCS) the tank (TNK-005A/B) to pump ammonia from.
4. With conditions normal and the tank (TNK-005A/B) selected to pump from, the recirculation ABV (ABV-161 or ABV-201) of the selected tank is commanded to open and verified (via limit switch).
5. When the recirculation ABV of the selected tank has been opened (via limit switch), the pump suction ABV (ABV-139 or ABV-141) of the selected tank is commanded to open and verified (via limit switch).
6. After the recirculation and pump suction ABVs have been opened, a pump start command is sent to the forwarding package control panel.
7. The operator must select one of the two pumps (P-012A/B) for forwarding ammonia via the DCS graphic.
8. In order to stop forwarding ammonia to the vaporizer (VPR-013), the operator will stop the pump (P-012A/B) via the DCS graphic.
9. The vaporizer ABV (ABV-165) is commanded to close and verified (via limit switch).
10. The pump suction ABV (ABV-139 or ABV-141) at the selected tank (TNK-005A/B) is commanded to close and verified (via limit switch).
11. The recirculation ABV (ABV-161 or ABV-201) at the selected tank (TNK-005A/B) is commanded to close and verified (via limit switch).

Automatic Shutdowns:

1. The liquid level of the selected tank (TNK-005A/B) is < 5%.
2. The pressure inside of the tank is less than or equal to negative 3 psig.
3. The nitrogen purging pressure is not satisfied (low)
4. The vaporizer level is > 95%, which is indicated by LT-528
5. Ammonia detection at the tank farm.

AMMONIA VAPORIZER SKID

Vaporizer Junction Box [JBX-602] (Located On Skid):

- vaporizer liquid level (AI)
- limit switch (DI)
- pneumatic actuated valve-ABV (DO)
- control valve (AO)
- line pressure (AI)
- line flow (AI)

Operation:

1. In order for the ammonia vaporizer package to operate, there must be an appropriate level (> or = to 55%) of liquid inside of the vaporizer (VPR-013), and the pressure must be at an operable pressure (< 135 psig).
2. When the vaporizer ABV (ABV-165) has been opened and verified (via limit switch), the ammonia level control valve (ACV-168) will maintain the level inside of the vaporizer (VPR-013) using the vaporizer level transmitter (LT-528) as the process variable. The level will be maintained based on a fixed set point. When a higher liquid level is required inside of the vaporizer (VPR-013), the level control valve (ACV-168) will open more, allowing more liquid to flow. When the desired level is reached, the level control valve (ACV-168) will close.
3. The pressure control loop will be based on an operator set point. For this loop, the pressure inside of the line (PT-526) is the process variable and will be controlled by the steam control valve (ACV-180). When the pressure needs to be increased, the steam control valve (ACV-180) will open more, allowing more steam to flow. As the pressure reaches the desired pressure, the pressure control valve (ACV-180) will actuate accordingly to maintain the appropriate pressure.
4. The ammonia flow control loop will be based on a DCS demand. As more flow is required, the ammonia flow control valve (ACV-177 or ACV-221) actuates to maintain the appropriate flow. As more ammonia is generated, the steam pressure loop and liquid level loop will adjust accordingly.

Automatic Shutdowns:

1. Liquid level (LT-528) inside of the vaporizer reaches a shutdown level.
2. Pressure (PT-526) inside of the line reaches a shutdown level.
3. Low low vapor temperature (TE-524) going to the dilution air package.
4. Dilution Air Fan Trips
5. Low Dilution Air Flow (FT-525/523)
6. Ammonia Leak
7. Aux Steam Pressure Low (PI-520/522)
8. Aux Steam Pressure High (PI-520/522)
9. Aux Steam Temperature High (TI-521)

AMMONIA DILUTION AIR PACKAGE

Dilution Air Heater Control Panel [cpl-605] (Located On Skid-Outside Of The Hazardous Location):

- emergency shutdown push button
- run permissive (DO)
- heater status (DI)
- heater temperature control (AO)
- pressure switch (DI)
- air flow rate (AI)
- heater vessel temperature (AI)
- heater outlet temperature (AI)
- limit switch (DI)
- pneumatic actuated valve-ABV (DO)

Operation:

1. In order for the dilution air package to operate, there must be a minimum air flow through the heater vessel, measured with the fan discharge flow transmitters (the sum of FT-537 and FT-538). This means that the fan outlet valve (Fan 21A = ABV-197; Fan 21B = ABV-198) must be open before starting the fan in the same line. There must not be a high heater bundle temperature (internal to CPL), high heater outlet temperature (TE-536), or high vessel temperature (TE-535).
2. There must first be a run permissive from the DCS.
3. After the run permissive is received at the heater control panel (CPL-605), the heater will start if the local high temperature output is not active.
4. An analog signal is sent to the heater control panel (CPL-605) from the main control system in order to fire the heater controllers.
5. In order to stop the heater, the run permissive is removed or the local emergency stop is pressed.

Automatic Shutdowns:

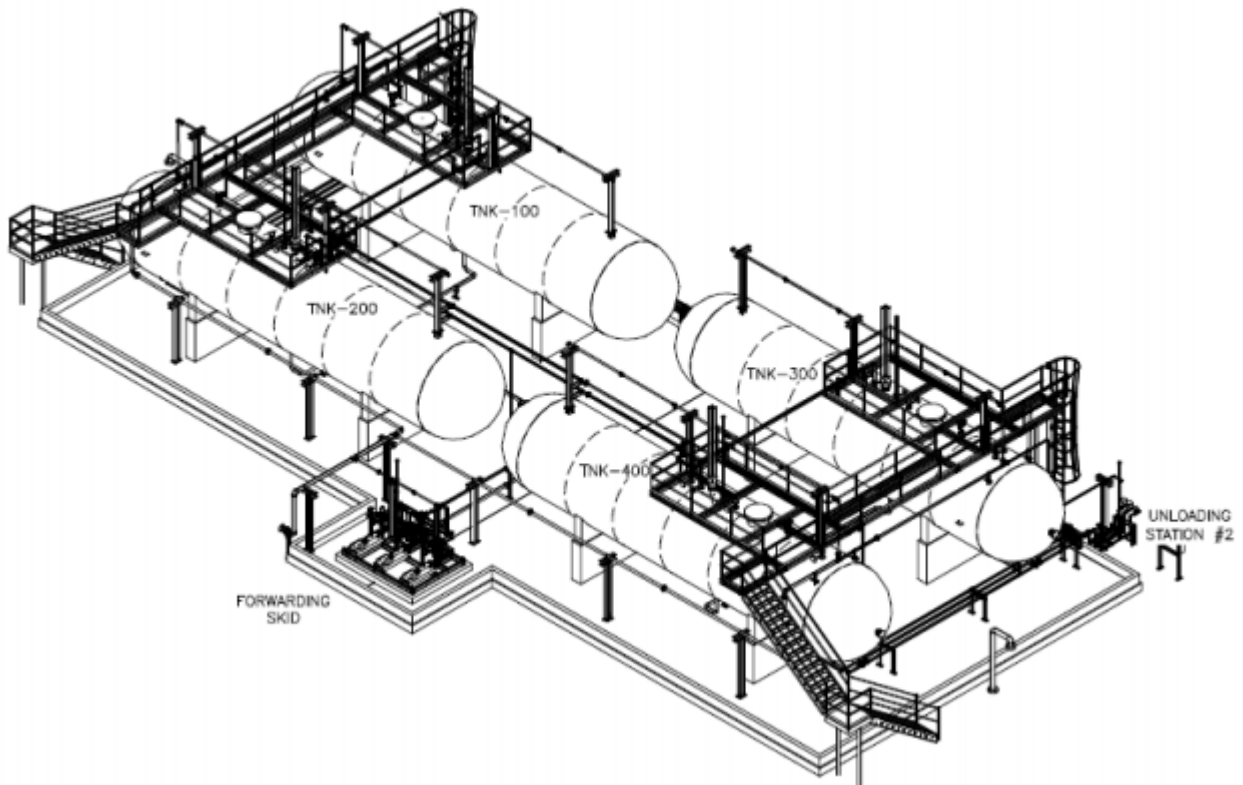
1. No air flow through the heater vessel (FT-537/538).
 2. High heater bundle temperature/Internal to control panel (CPL-605)
 3. High heater outlet temperature (TE-536)
 4. Low Heater outlet temperature (TE-536)
 5. High Vessel (HT-025) temperature (TE-535)
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- **For Ammonia in Any State:**
 - **Aqueous**
 - **Anhydrous**

IFS can configure an entire Ammonia Storage Tank Farm, or replace or add a process unit on an existing one (unloading station, forwarding skid, etc.) to meet your specifications and needs anywhere in the world.

Below is a schematic of a system with four (4) ammonia storage tanks and two (2) truck unloading stations. We also do train tank car unloading towers, and systems for hot and cold ammonia.



Typical Schematic for a Four (4) Tank Ammonia Storage SCR Ammonia Handling System with Two(2) Truck Unloading Stations and a Single Forwarding Skid