OFFSITE CONSEQUENCE ANALYSIS

Basin Electric Power Cooperative
Lonesome Creek Station, ND

Offsite Consequence Analysis
EPA Risk Management Regulation (40 C.F.R. 68)

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1. EXECUTIVE SUMMARY

The Basin Electric Power Cooperative (BEPC) Lonesome Creek Station (LCS) in Williston, North Dakota (Facility) is planning the addition of two 45 megawatt GE LMP6000 PC natural gas fired combustion turbines to its existing facility containing one equivalent turbine. The project will increase the need for anhydrous ammonia for selective catalytic reduction (SCR) and will require on site storage of anhydrous ammonia in a quantity greater than 10,000 pounds. Therefore, the Facility will be required to meet the federal provisions contained in 40 C.F.R. Part 68 which requires the submittal of a risk management plan (RMP). The facility is subject to the Program 3 requirements for anhydrous ammonia which includes an Offsite Consequence Analysis (OCA) for anhydrous ammonia that identifies the impacts that an accidental release would have on the surrounding population and nearby environmental and public receptors. The OCA must include worst-case and alternative release scenarios.

The worst-case scenario is based on a release of the largest quantity of a regulated substance from a vessel or process line failure. To determine the impacts that such a release would have on the population and nearby environmental and public receptors, the worst-case scenario was modeled using the U.S. EPA SLAB model, developed for dense gas release, through *BREEZE™ Incident Analyst*. The Facility's worst-case release scenario is a release of the largest storage tank (8,500 pounds) of anhydrous ammonia over ten minutes. The modeled worst-case scenario impact radius was determined to be 2.17 miles, with a total affected population of 250. Within the 2.17 mile radius, nearby industrial and residence receptors would be impacted, but no other public receptors were identified.[1] There are no affected offsite environmental receptors within the radius of impact.

The alternative release scenario must be more likely to occur than the worst-case scenario yet still reach an endpoint offsite, unless no such scenario exists. The alternative release scenario chosen was also modeled using SLAB for an accidental release of 2,460 lbs from a failure during tank loading. While preventative measures are in place to avoid this kind of accident, it was chosen as the most likely release scenario which would reach an endpoint offsite. The modeled alternative release scenario radius of impact is 0.56 miles, which would impact nearby industrial receptors, as well as a total estimated population of 60 persons due to a nearby mobile home park. There are no affected offsite environmental receptors within the radius of impact.

This report provides the worst-case and alternative release scenario analyses and supporting information required for submission in BEPC's Risk Management Plan.

1.1. REGULATED SUBSTANCES

Substances are regulated under the RMP program when they exceed the threshold quantities listed in 40 C.F.R. § 68.130. Anhydrous ammonia (CAS No. 7664-41-7) is regulated under the RMP program. The threshold quantity for ammonia in a single process is 10,000 lbs. The maximum storage capacity for two interconnected tanks is approximately 17,000 lbs.[2] which exceeds the threshold quantity of 10,000 lbs. Therefore, anhydrous ammonia is a regulated substance under the RMP program at the Facility. No other substances present at the Facility are regulated under the RMP program.

[1] "Public receptor" means offsite residences, institutions, office buildings, parks, or recreational areas inhabited or occupied by the public at any time and "Environmental receptor" means natural areas, preserves, refuges, etc. 40 C.F.R. 68.3.

[2] Each tank is sized for approximately 10,000 lbs. (2000 gallons) of anhydrous ammonia, and limited to a maximum capacity of 85%, or 8,500 lbs. August 15, 2013 email from Joe Fiedler, BEPC, to Will Backus, Trinity Consultants.

1.2. COVERED PROCESSES

The term "process" is defined in 40 C.F.R. § 68.3 as:

> *… any activity involving a regulated substance including any use, storage, manufacturing, handling, or on-site movement of such substances, or combination of these activities. For the purposes of this definition, any group of vessels that are interconnected, or separate vessels that are located such that a regulated substance could be involved in a potential release, shall be considered a single process*

At the Facility, the anhydrous ammonia system is covered under a single process. This process includes the unloading of anhydrous ammonia to a storage tank, storage, dilution with air, and process feed injection of ammonia.

1.3. WORST-CASE RELEASE SCENARIO

A "worst-case release" is defined in § 68.3 as:

> *"… the release of the largest quantity of a regulated substance from a vessel or process line failure that results in the greatest distance to an endpoint defined in § 68.22(a)."*

The worst-case release scenario quantity is defined in § 68.25(b) as the greatest amount in any single vessel or pipe used in a covered process, taking into account administrative controls that limit the maximum quantity. The Facility has two identically sized ammonia storage vessels. Since both vessels are located in close proximity to each other, the impacts from the worst-case release should be nearly identical. Regulated substances and covered processes under the RMP program are covered in Sections 2.1 and 2.2, respectively.

The RMP program sets forth parameters that define worst-case release scenario conditions, including meteorological conditions, release endpoints, and release scenarios.

Endpoint distance can be determined using the methodology provided in the RMP Offsite Consequence Analysis Guidance (OCAG) or any commercially or publicly available air dispersion modeling techniques, provided the techniques account for the specified modeling conditions and are recognized by industry as applicable as part of current practices. Proprietary models that account for the modeling conditions may be used provided the owner or operator allows the implementing agency access to the model and describes model features and differences from publicly available models to local emergency planners upon request.[3]

1.4. ALTERNATIVE RELEASE SCENARIO

In addition to the worst-case release scenario, the RMP program also requires that an alternative release scenario be identified for each regulated substance. The scenario must be more likely to occur than the worst-case release scenario, and must reach an endpoint offsite, unless no such scenario exists. The alternative release scenarios should include, but are not limited to, the following, where applicable:[4]

(i) Transfer hose releases due to splits or sudden hose uncoupling;
(ii) Process piping releases from failures at flanges, joints, welds, valves and valve seals, and drains or bleeds;
(iii) Process vessel or pump releases due to cracks, seal failure, or drain, bleed, or plug failure;

[3] U.S. EPA "Risk Management Program Guidance for Offsite Consequence Analysis", EPA 550-B-99-009, March 2009.

[4] Alternative release scenarios are outlined under 40 C.F.R. § 68.28(b)(2).

(iv) Vessel overfilling and spill, or over pressurization and venting through relief valves or rupture disks; and
(v) Shipping container mishandling and breakage or puncturing leading to a spill.

Endpoint distances are determined using the same methodology as used for the worst-case release scenario except that active and passive mitigation systems may be considered provided they are capable of withstanding the event that triggered the release and would still be functional.[5]

1.5. POPULATION AND ENVIRONMENTAL IMPACTS

The Facility is required to define offsite impacts from the worst-case and alternative release scenarios. Specifically, the following information is required in the RMP:

- Population:
  - Estimate the population within a circle with its center at the point of the release and a radius determined by the distance to endpoint. Population shall be estimated to two significant digits.
  - Note the presence of public receptors.

- Environmental:
  - List environmental receptors within a circle with its center at the point of the release and a radius determined by the distance to endpoint.[6]

Acceptable sources for population data include the most recent Census data. In this analysis, the MARPLOT program is used to estimate potentially affected population within the distance to endpoint and to identify public receptors. MARPLOT pulls demographic information from the 2010 Census.

[5] U.S. EPA "Risk Management Program Guidance for Offsite Consequence Analysis", EPA 550-B-99-009, March 2009.

[6] "Environmental receptor" is defined as natural areas such as national or state parks, forests, or monuments; officially designated wildlife sanctuaries, preserves, refuges, or areas; and Federal wilderness areas, that could be exposed at any time to toxic concentrations, radiant heat, or overpressure greater than or equal to the endpoints provided in 40 C.F.R. § 68.22(a), as a result of an accidental release and that can be identified on local U.S. Geological Survey maps. 40 C.F.R. § 68.3.

This section contains a description of the anhydrous ammonia storage and handling system, selection of release scenarios, and a summary of the OCA. The toxic endpoint of anhydrous ammonia is listed in Appendix A of 40 C.F.R. 68 as 0.14 mg/L. [7]

2.1. DESCRIPTION OF AMMONIA STORAGE AND HANDLING

Anhydrous ammonia is unloaded from trucks and stored in one of the two ammonia storage tanks. The total quantity of ammonia in each tank is 8,500 lbs.[8] A 1.1 foot (above ground level at base) earthen dike surrounds the land where both tanks are located, and is considered passive mitigation.[9] However, due to the modeled release type (vapor/ aerosol mixture), the earthen dike had no effect in the model.

2.2. SELECTION OF WORST-CASE RELEASE

The greatest amount of anhydrous ammonia present at the Facility is in the storage tanks. Two ammonia tanks are located together at a single location and are the same size. Therefore, the worst-case release was chosen as the release of the maximum contents of one tank.

2.3. WORST-CASE RELEASE SCENARIO ANALYSIS AND RESULTS

Ammonia is a gas at ambient temperature (77°F) and is therefore considered a gas in the RMP OCAG.[10] Both storage tanks are located outdoors.

Since the ammonia is a gas at ambient temperature (77°F) it is considered a toxic gas. For toxic gases the RMP program specifies that the entire release take place over a period of 10 minutes. The maximum capacity of the storage tank is 8,500 lbs of ammonia, and therefore the release rate is modeled at 850 lbs/min.

Since a release of anhydrous ammonia forms an aerosol mixture which is denser than air, a heavy vapor dispersion model is required to adequately predict airborne concentrations. [11] For the purposes of this OCA, the SLAB model was used to determine the distance to toxic endpoint as it is one of the EPA's recommended models for denser than air releases and was used by the EPA to develop the RMP OCAG. SLAB is listed by EPA as an alternate model for modeling denser-than-air releases.[12] SLAB directly accounts for the surface roughness of the area surrounding the facility. The dispersion rate of the plume is calculated based on dispersion coefficients, which are impacted by the surface roughness. The more generalized RMP*Comp, which can be used for RMP modeling, only allows for the selection of either urban or rural dispersion coefficients. The surface roughness factor in SLAB was chosen to be 0.1 m, corresponding to the seasonal surface roughness for rural (grasslands,

7 The toxic endpoint of 0.14 mg/L is equivalent to 201 ppm, based on conversion using density of ammonia at standard temperature and pressure (0.696 kg/m^3) from NIST Material Measurement Laboratory Isobaric Properties for Ammonia. See Section 3 Summary of Endpoints for full conversion.

8 Each tank is sized for approximately 10,000 lbs. (2000 gallons) of anhydrous ammonia, and limited to a maximum capacity of 85%, or 8,500 lbs. August 15, 2013 email from Joe Fiedler, BEPC, to Will Backus, Trinity Consultants.

9 Dike information taken from the August 13 email from Josh Rossow, Basin Electric, to Will Backus, Trinity Consultants.

10 Technical Background Document for Offsite Consequence Analysis for Anhydrous Aqueous Ammonia, Chlorine, and Sulfur Dioxide, Chemical Emergency Preparedness and Prevention Office, U.S. Environmental Protection Agency, May 1999

11 Id.

12 EPA SCRAM website, http://www.epa.gov/scram001/dispersion_alt.htm.

herbaceous, low crops, etc.) topography.[13] Row crops and grasslands make up the majority of the surrounding land features within the worst-case area of impact.

A summary of the input parameters used for modeling are included in Table 2-1.

Table 2-1: Input Parameters for Worst-Case Scenario Modeling Analysis

Parameter	Value
Release Type	Tank
Wind Speed (m/s) [1]	1.5
Maximum Ambient Temperature (°F) [2]	100
Atmospheric Stability Class [1]	F
Relative Humidity (%) [2]	65.7
Release Height (ft) [1]	0
Release Rate (lbs/min)	850
Release Duration (min) [1]	10
Storage Temperature (°F) [3]	105
Storage Pressure (psi) [3]	215
Surface Roughness (m) [4]	0.1
Toxic Endpoint (mg/L) [1]	0.14

Notes for Table 2-1:
[1] 40 C.F.R. § 68.22.

[2] As required by 40 C.F.R. § 68.22, the maximum daily temperature and humidity were chosen from past 3 years of data, per guidance from 40 CFR 68.22(b) for worst case, taken from http://www.wunderground.com/history/airport/KISN/.

[3] Pressure equals 215 psi and temperature equals 105 F. August 13, 2013 email from Josh Rossow, BEPC, to Will Backus, Trinity Consultants.

[4] Surface roughness factor was chosen to be 0.1 m, corresponding to rural (Grasslands/Herbacious/ Low Crops) topography, per guidance from 40 CFR 68.22(e) and EPA's AERSURFACE Userguide (http://www.epa.gov/scram001/7thconf/aermod/aersurface_userguide.pdf).

[13] The surface roughness factor was approximated from Table A-3 Seasonal Values of Surface Roughness (m) for the NLCD92 21-Land Cover Classification System, located in: EPA. AERSURFACE User's Guide. January 2008.

Figure 2-1: Map for Worst-case Release Scenario
(Radius of Impact = 2.17 miles)

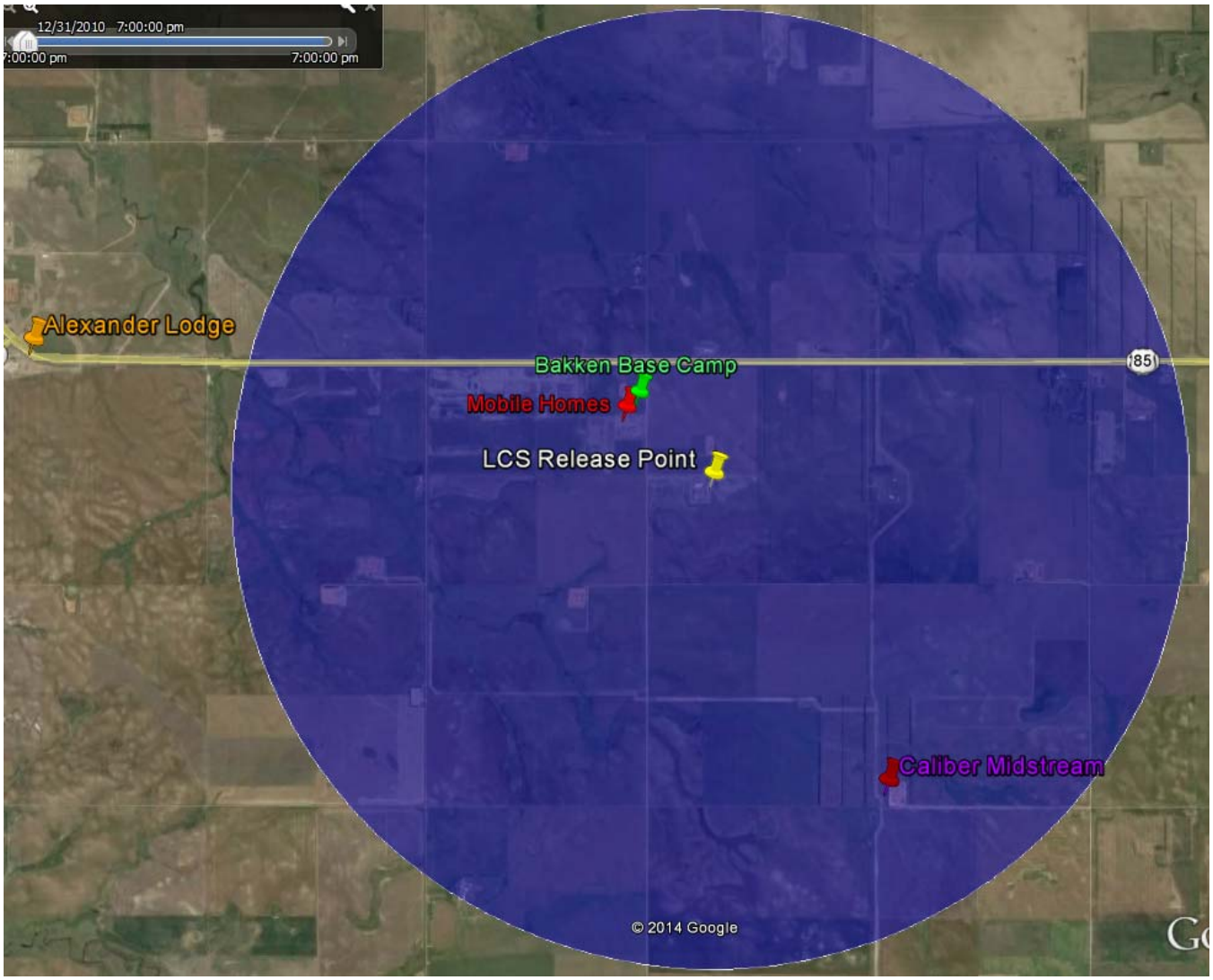


Figure 2-1 shows the resulting maximum distance to the endpoint of 201 ppm (0.14 mg/L) was calculated as 2.17 miles. The detailed SLAB input and output information is provided in Appendix A: SLAB Model Parameters. Figure 2-1 also shows the approximate location of Alexander Lodge (Orange), the Bakken Base Camp (Red), Caliber Midstream facility (Purple) and the mobile home park (Green) in reference to the release point. In addition, the ONEOK Lonesome Creek natural gas plant is located within the worst-case scenario radius. The nearby public receptors are discussed further below.

Figure 2-2: Aerial view of the Bakken Base Camp and Mobile Homes in Comparison to LCS

Figure 2-2 shows the location of LCS as compared to the Bakken Base Camp and the mobile home park.[14] MARPLOT was used to analyze the affected population and environmental receptors. The MARPLOT output for the worst-case release scenario indicated the total affected population using 2010 census data is 31 people. In addition to the official census data, BEPC is aware of two local man camps nearby the facility: Alexander Lodge and Bakken Base Camp. Alexander Lodge houses around 340 residents[15] and Bakken Base Camp can house a total of 144 residents[16]. Alexander Lodge is located north of Highway 85 at the intersection of 68, which falls outside of the worse-case radius. However, Bakken Base Camp, housing around 144 persons and located on the south side of HWY 68 is within the Worst Case Scenario radius of impact[17]. In addition to the man camps, the region also has a series of roughly 30 mobile homes next to the Bakken Base Camp as shown on Figure 2-2[18]. The radius of impact therefore includes an additional 60 persons assuming there are roughly 2 people per mobile home currently residing in the mobile home park. The MARPLOT population output results for the worst-case release scenario are shown in Figure 2-3. A conservative estimate of 250 total residents was used for the worst-case release impacted population to account for the MARPLOT 2010 Census data, Bakken Base Camp, and mobile homes. A population growth factor was applied to the 2010 Census data as described in Table 2-2.

[14] Image and locations provided by Josh Rossow in a January 7, 2014 e-mail.

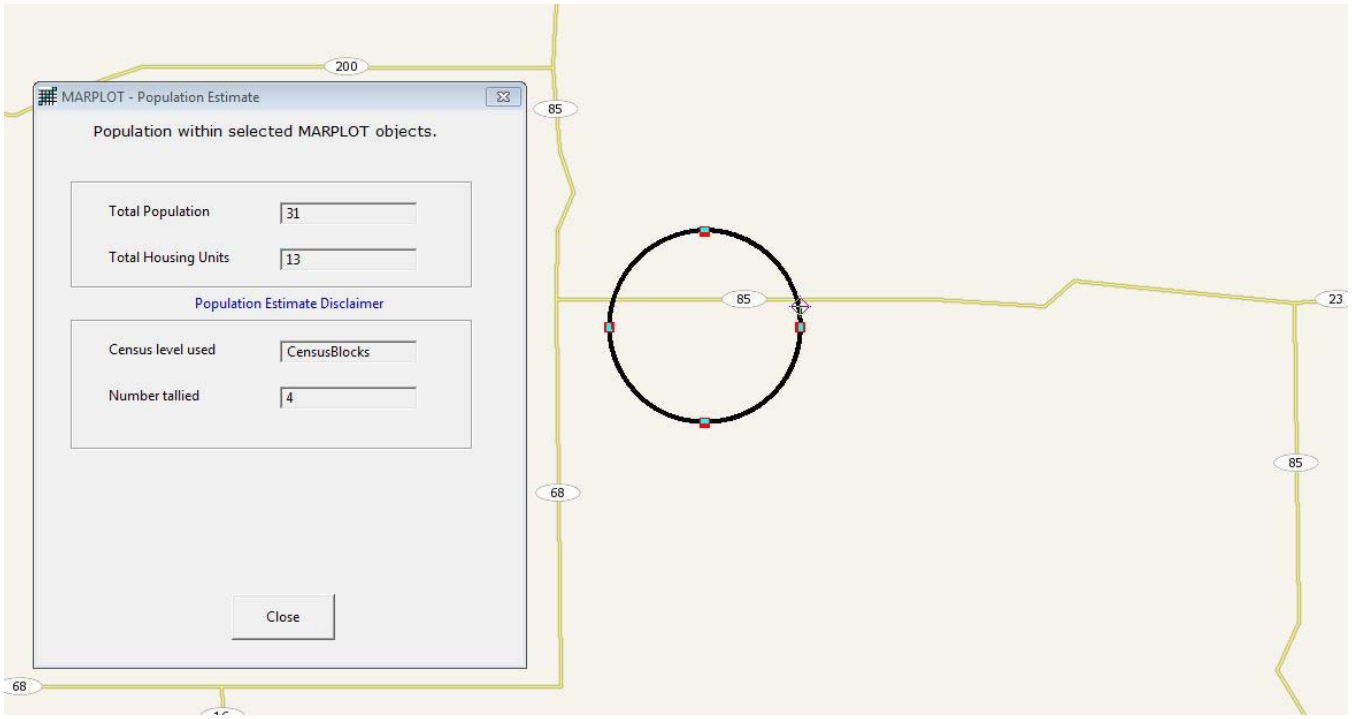
[15] Alexander Lodge: 14050 U.S. 85, Alexander, ND 58831. Per phone conversation between Divya Narasimhan, Trinity, and Alexander Lodge representative, November 5, 2013.

[16] Bakken Base Camp resident population source: http://www.goliath-industries.com/Bakken_base_camp .

[17] Bakken Base Camp location provided in December 17, 2013 email from Josh Rossow, BEPC, to Christine Kurtz, Trinity.

[18] The location and capacity of the mobile homes were determined as per January 7, 2014 e-mail from Josh Rossow.

Figure 2-3: MARPLOT Population Output for the Worst-case Release Scenario



Google Earth was used to analyze public receptors within the radius of impact of the worst-case release scenario, as these are not identified in MARPLOT. No schools, churches, libraries and similar institutions are located within the worst-case release scenario radius of impact. Google Earth was also used to confirm environmental receptors within the distance to toxic endpoint, examined initially using U.S Geological Survey (USGS) topographic maps.

The model results, and public and environmental receptors analyses, are summarized in Tables 2-2 through 2-4 for the worst-case release scenario.

Table 2-2: Worst-Case Scenario Modeling Analysis Results

Parameter	Value
Impact Radius (miles)	2.17
Affected Population – MARPLOT[1] (persons)	31
Affected Population 2013 Estimate[2,3] (persons)	250

1. From MARPLOT Tool: The population and housing numbers are rough estimates based on the year 2010 census blocks. Marplot uses the centroid, or center point, rather than the entire polygon. Therefore if a census block centroid is within the requested area, the population and housing numbers for that block are tallied, even if only part of the block is within the area.
2. Affected Population in 2013 estimated from 2010 MARPLOT affected population using population growth rate between 2000 and 2010 for McKenzie County, ND, 10.86% annually. Source: http://www.usa.com/mckenzie-county-nd.htm
3. The Affected Population in 2013 includes both the estimated population from MARPLOT (46 people) as well as 144 persons from the Bakken Base Camp and 60 from the nearby mobile home park located within the radius of impact. Mobile home park residents estimated based from January 7, 2013 email from Josh Rossow, BEPC. Bakken Base Camp source: http://www.goliath-industries.com/Bakken_base_camp.

Table 2-3: Public Receptors within Impact Area for Worst-Case Scenario

Public Receptor	Within Impact Area
Schools	No
Residences	Yes
Hospitals	No
Parks and Recreational Areas	No
Commercial, Office, or Industrial Areas	Yes

Table 2-4: Environmental Receptors within Impact Area for Worst-Case Scenario

Environmental Receptor	Within Impact Area
National or State Parks	No
Fish and Wildlife Service	No
Forest Service	No

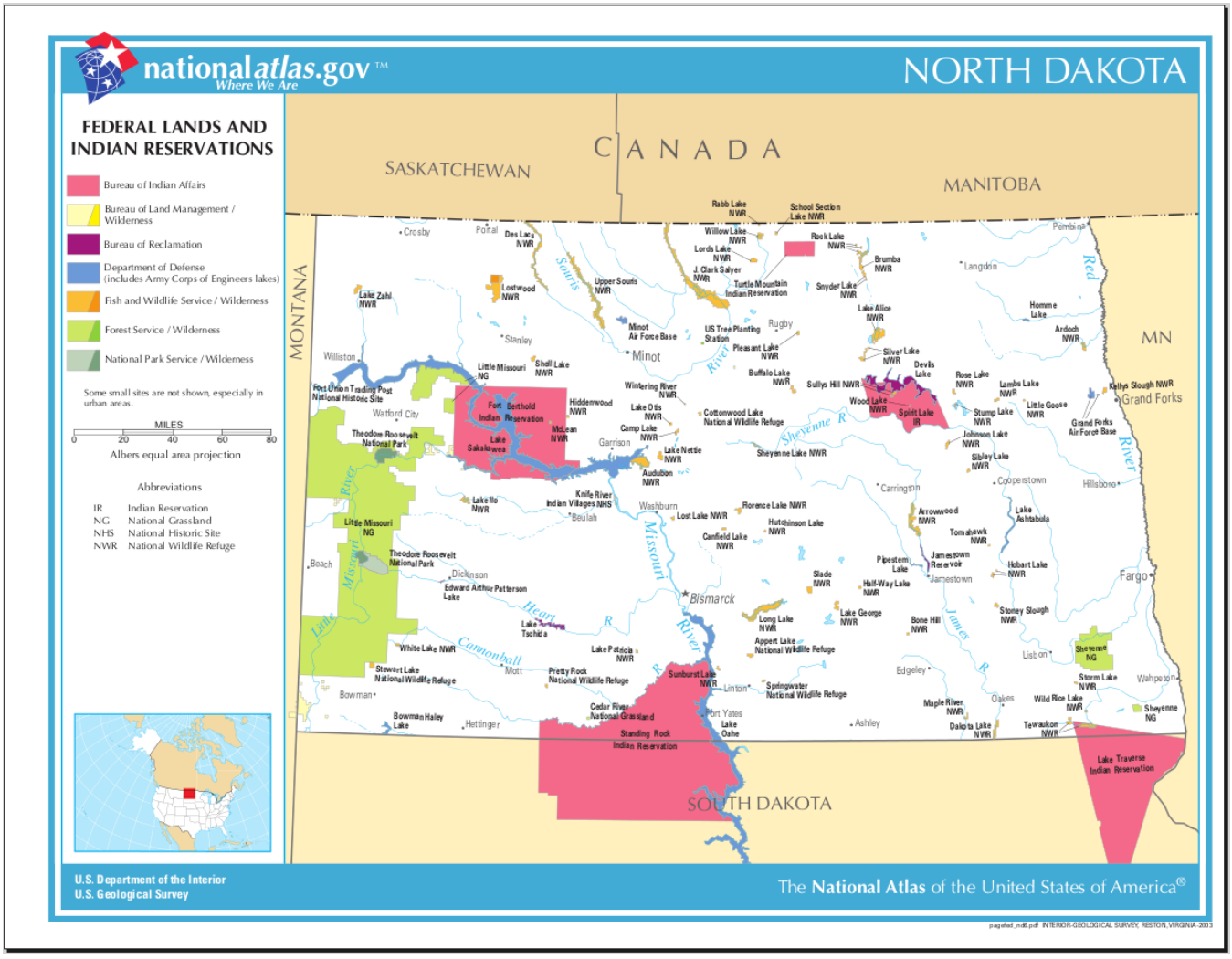
McKenzie County, North Dakota has seen a dramatic population increase in recent years. The most recently available census data from 2010 may underestimate the affected population, so a growth factor was applied to affected population. The 2013 affected population was estimated assuming a growth rate of 10.86%[19] beginning with the 2010 census data calculated using MARPLOT. In addition to the scaled 2010 census data, the full capacity of the Bakken Base Camp is included in the total affected population. Industrial/commercial areas also

[19] Mckenzie county population growth source: http://www.usa.com/mckenzie-county-nd.htm

exist within the impact area from the worst case release scenario, including the Missouri River Asphalt plant, Watson Private Air strip, as well as several small tank farms.

The closest State or National Park environmental receptor is Theodore Roosevelt National Park, roughly 10 miles southeast of the Facility and outside of the worst-case radius. Figure 2-4 shows the closest Fish and Wildlife preserves, Lake Zahl and Lake Ilo, which fall outside of the worst-case radius. No National Forests or Grasslands are located within the worst-case release impact radius.

Figure 2-4: Federal Lands and Indian Reservations in North Dakota (U.S. Department of Interior)



2.4. SELECTION OF ALTERNATIVE RELEASE SCENARIO

Multiple alternative release scenarios for an anhydrous ammonia release were evaluated in order to determine the most likely release scenario which could lead to an impact outside of the Facility's site boundaries. A list of potential alternative release scenarios was developed by taking into account failure scenarios discussed in the ammonia system Process Hazard Analysis and using ammonia process knowledge, including existing operating procedures and safety systems, to subjectively evaluate the likelihood of release events. The following sections describe each of the four analyzed release scenarios, along with reasoning behind the selection of the modeled alternative release scenario - an ammonia release during tank loading from a faulty seal or flex hose release.

2.4.1. Safety Relief Valve Lift from Heater Malfunction on Vaporizer

This release scenario would involve a malfunction of the heater on the vaporizer, leading to an overheated ammonia gas stream (PHA scenario). The system is equipped with a temperature alarm, which would automatically alert the operator of a temperature malfunction. If the operator was unable to respond to the heater malfunction in time, ammonia vapor would release from the safety relief valves, set to lift at 250 pounds per square inch (PSI). Because of the low likelihood of a heater malfunction, combined with a temperature alarm malfunction or inability for the operator to respond, this scenario was not chosen as the alternative release scenario.

2.4.2. Pipe connection failure on Vaporizer

The second possible alternative release scenario involves a break in the piping connection between the vapor liquid supply line and the two vaporizer heaters. The likelihood of this event is low since the pipes are coupled together, and there is a hydrostatic relief valve on the vaporizer liquid supply. If the pipe connection were to fail, a liquid release would potentially cause a small pool of anhydrous ammonia. While the release may potentially reach an endpoint offsite, more likely scenarios were examined.

2.4.3. Tank Overfill

A facility operator will be present during the entire filling operation in addition to the truck operator; however, there is no automatic shutoff on the tank in case of a potential overfill (PHA scenario). A tank overfill could cause the safety valves on the top of the anhydrous ammonia storage tanks to lift. The total amount of ammonia released during this scenario would likely be low because if the tank were to accidentally overfill, the two operators would be able to close the emergency shutoff valve on the truck loading line.

2.4.4. Flex Hose Release During Filling

The filling process for the two ammonia storage tanks involves connecting a 2 in. inner diameter flex hose from the ammonia delivery truck to the 2 in. liquid fill line via aluminum couplings. Ammonia is stored as a liquid at near ambient temperature in the delivery truck. An accidental release could occur from a failure on the flex hose coupling, faulty seal, or flex hose line crack (PHA scenario). While operators would be present, the high flow rate during ammonia loading in the flex hose could lead to a release of ammonia at ambient temperature over as short a time-span as a few minutes. This scenario was chosen as the modeled alternative release scenario due to the relatively high likelihood compared to other potential releases, as well as the probability of a toxic gas endpoint offsite.

2.5. ALTERNATIVE RELEASE SCENARIO ANALYSIS AND RESULTS

BEPC chose the release of ammonia from a flex hose connection failure or crack during truck unloading based on a review of potential release scenarios, as summarized in Section 2.4. This scenario encompasses the possibility of a hose crack at any point during the unloading process. During truck unloading (tank loading), pressurized liquid ammonia near ambient temperature is pumped into the tanks via a 2 in. diameter flex hose, coupled to the 2 in. liquid fill fitting on the liquid fill line. During the most recent fill, liquid ammonia was loaded at approximately 517 lbs/min (8,000 lbs over approximately 14 minutes).[20] The release duration was approximated as 5 minutes, which would be the maximum time that the facility and truck operators would need to respond to any potential crack, leak, or flex hose release (less likely) by closing the emergency shutoff valve located on the truck.

For alternative release scenarios, the RMP rule states that typical meteorological conditions may be used. Typical meteorological conditions for the Facility were determined using meteorological data for the weather station at the Sloulin Field International Airport in Williston, North Dakota (KISN) from the years 2010-12. A summary of the meteorological data used in the modeling analysis is included in Appendix A.

The release was conservatively modeled as a vapor/ aerosol jet plume assuming ammonia is stored at ambient temperature in the tanker truck. The storage pressure was conservatively assumed equal to the vapor pressure of ammonia at that temperature. The RMP OCAG states that the modeled ambient temperature for an alternative release should be chosen as the average temperature of the location. The modeled ambient temperature for LCS was taken as the average temperature from the previous three years of temperature data from the nearest meteorological station[21], 42.3 F. This temperature was used as the ammonia storage temperature as well. The release point was chosen as the liquid fill fitting, which is near the facility fenceline due to the location of the ammonia storage tanks and approximately 4 feet above ground level. The release rate was calculated assuming instantaneous vaporization of ammonia from a crack in a pipe with diameter 2 in. from an unlimited liquid supply using Breeze Incident Analyst. The crack area was assumed to be half the area of the pipe end, simulating a crack in between two of the flex rings on the hose. Using the duration and calculated release rate, the total mass released was calculated to be 2,460 lbs.[22]

Similar to the worst-case scenario, the distances to toxic endpoints were determined using the SLAB model. The input parameters include weather conditions as well as release characteristics, and are summarized in Table 2-5.

[20] Ammonia loading numbers from October 11, 2013 email from Josh Rossow, BEPC, to Will Backus, Trinity.

[21] The nearest meteorological station to LCS is the KISN weather station at Williston, ND.

[22] Release rate is lower than the liquid flow rate of 571 lb/min due to the estimated release area.

Table 2-5: Input Parameters for Alternative Release Scenario Modeling Analysis

Parameter	Value
Release Type	Pipe
Wind Speed (m/s) [1]	3
Average Ambient Temperature (°F) [2]	42.3
Atmospheric Stability Class [1]	D
Relative Humidity (%) [2]	65.7
Release Height (ft) [3]	4
Release Rate (lbs/min) [4]	492
Release Duration (min) [4]	5
Storage Temperature (°F) [5]	42.3
Storage Pressure (psi) [5]	75.9
Surface Roughness (m) [6]	0.1

[1] U.S. EPA "Risk Management Program Guidance for Offsite Consequence Analysis", EPA 550-B-99-009, March 2009.

[2] Taken from historical weather data for KISN weather station at Williston, ND from www.wunderground.com.

[3] Release height taken as height of liquid ammonia fill coupling.

[4] Release scenario assumes 2,460 lbs. of ammonia escapes, based on release time of 5 minutes and calculated release rate of 492 lb/min of ammonia vapor.

[5] Storage conditions at modeled ambient temperature.

[6] Surface roughness factor was chosen to be 0.1 m, corresponding to rural (Grasslands/Herbacious/ Low Crops) topography, per guidance from 40 CFR 68.22(e) and EPA's AERSURFACE Userguide (http://www.epa.gov/scram001/7thconf/aermod/aersurface_userguide.pdf).

Figure 2-5 shows the resulting maximum distance to the endpoint of 201 ppm (0.14 mg/L) was calculated as 0.56 miles. The detailed SLAB input and output information is provided in Appendix A: SLAB Model Parameters. Figure 2-5 also shows the locations of Bakken Base Camp (Red) and the mobile home park (Green) relative to LCS.

Figure 2-5: Map for Alternative Release Scenario
(Radius of Impact = 0.56 miles)

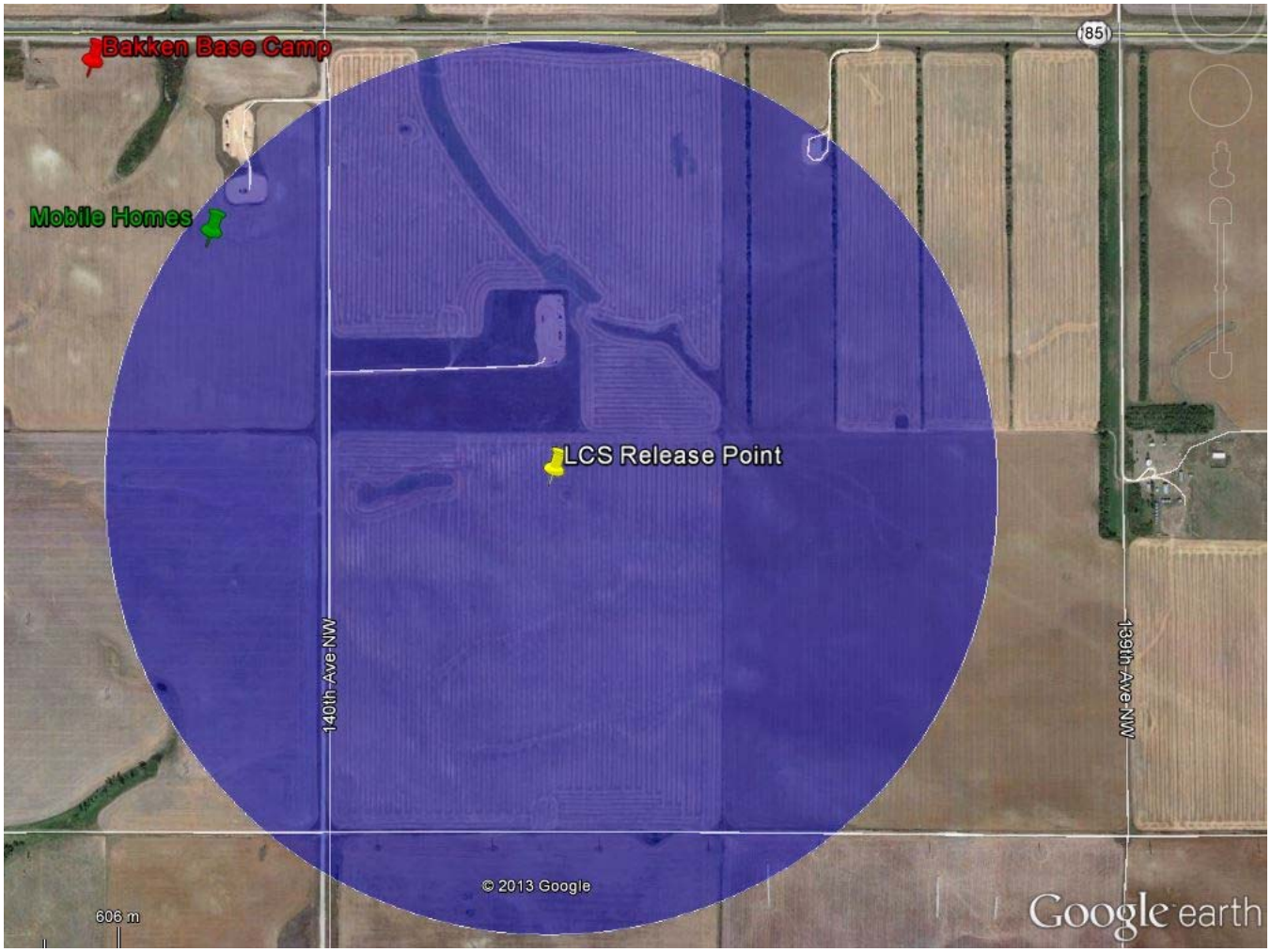
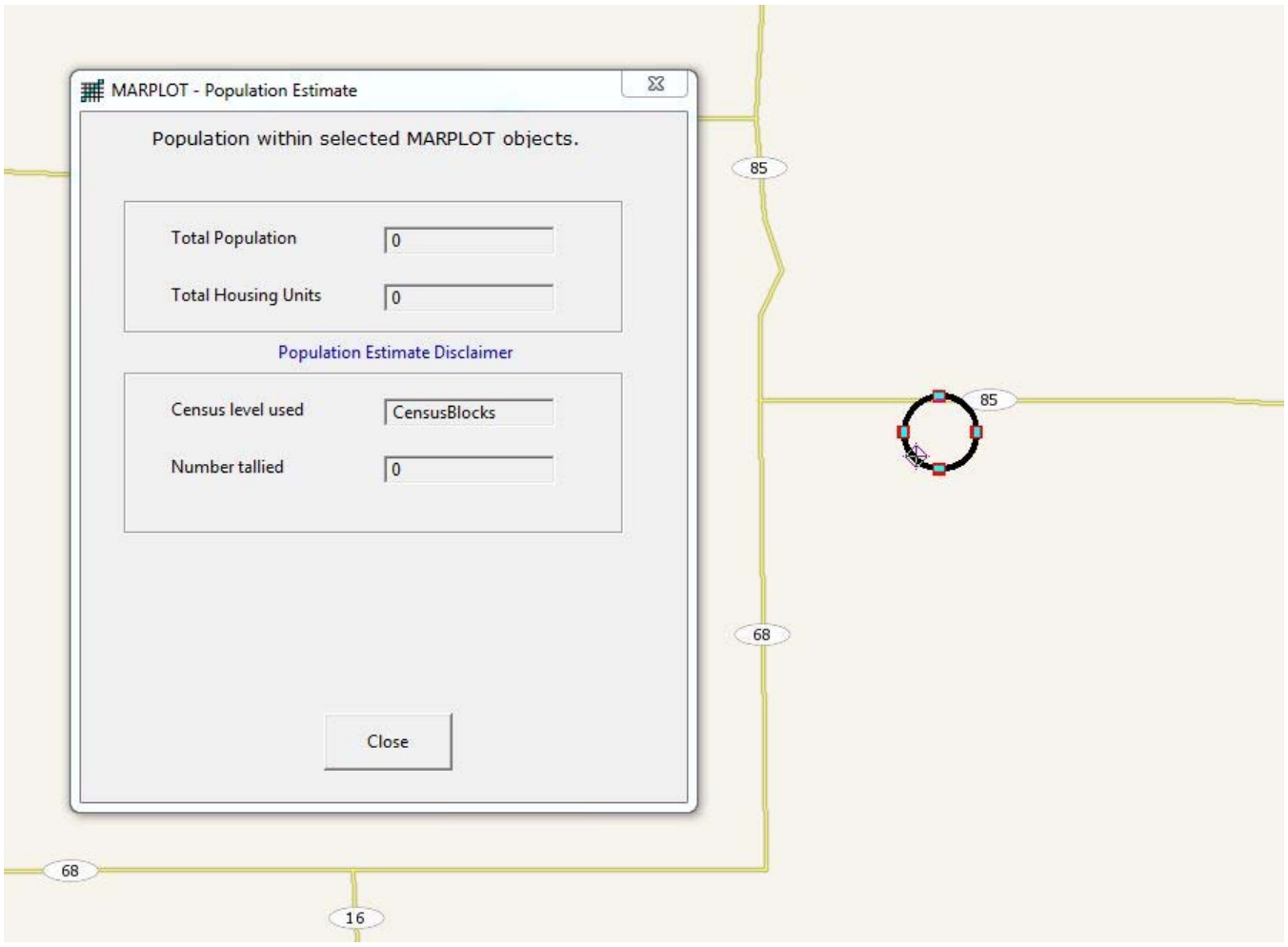


Figure 2-6 shows the MARPLOT output for the alternative release scenario, which indicated the total affected population using 2010 census data is 0 people. The surrounding area was reviewed through Google Earth, as well as local knowledge, in order to determine the accuracy of the MARPLOT results that there are likely no residences within 0.56 miles of the release point. However, based on BEPC's knowledge of the surrounding area, there are approximately 30 mobile homes parked in the land next to Bakken Base Camp as shown in Figure 2-5 and Figure 2-2[23]. As a result, the affected population for the alternative release scenario was estimated as 60 persons, under the assumption of an average of 2 residents per mobile home.

Similar to the worst-case scenario, Google Earth was used to analyze public receptors within the radius of impact of the alternative release scenario, as these are not identified in MARPLOT. No schools, churches, libraries and similar institutions are located within the alternative release scenario radius of impact. A small tank farm exists just to the north and does fall within the alternative release scenario radius. Google Earth was also used to confirm that there are no environmental receptors located within the alternative release scenario radius of impact. The closest receptors are discussed in the worst-case release scenario section.

[23] The location and capacity of the mobile homes were determined as per January 7, 2014 e-mail from Josh Rossow.

Figure 2-6: MARPLOT Population Output for the Alternative Release Scenario



The model results, and public and environmental receptors analyses, are summarized in Tables 2-6 through 2-8 for the alternative release scenario.

Table 2-6: Alternative Release Scenario Modeling Analysis Results

Parameter	Value
Impact Radius (miles)	0.56
Affected Population – MARPLOT[1] (persons)	60

1. From MARPLOT Tool: The population and housing numbers are rough estimates based on the year 2010 census blocks. Marplot uses the centroid, or center point, rather than the entire polygon. Therefore if a census block centroid is within the requested area, the population and housing numbers for that block are tallied, even if only part of the block is within the area.
2. The Affected Population in 2013 includes 60 persons from the mobile home park located within the radius of impact. Mobile home park residents estimated based from January 7, 2013 email from Josh Rossow, BEPC.

Table 2-7: Public Receptors within Impact Area for Alternative Release Scenario

Public Receptor	Within Impact Area
Schools	No
Residences	Yes
Hospitals	No
Parks and Recreational Areas	No
Commercial, Office, or Industrial Areas	Yes

Table 2-8: Environmental Receptors within Impact Area for Alternative Release Scenario

Environmental Receptor	Within Impact Area
National or State Parks	No
Fish and Wildlife Service	No
Forest Service	No

3. SUMMARY OF ENDPOINTS

Table 3-1 summarizes the radius of impact from the accidental release scenario analyses. The calculation of the toxic endpoint concentration in ppm (units used in Incident Analyst model) from 0.14 mg/L is shown in footnote 1.

Table 3-1: Distances to endpoint from accidental release scenario analyses

Anhydrous Ammonia Toxic Endpoint: 201 ppm[1]			
Case	**Model Run**	**Distance to Endpoint (m)**	**Distance to Endpoint (miles)**
Worst-Case Scenario	R1	3,487	2.17
Alternative Release Scenario	R1	900	0.56

1. Toxic Endpoint calculated from 0.14 mg/L Toxic endpoint listed in Appendix A to 40 C.F.R. Part 68 - Table of Toxic Endpoints.

ppm = µL ammonia/ L air =	201.1

*Where the density of ammonia at 25 C is 0.696 kg/m^3 at standard temperature and pressure from NIST Material Measurement Laboratory Isobaric Properties for Ammonia.

$$\text{ppm} = \frac{.14\ \text{mg}}{\text{L}} * \frac{\text{m}^3}{.696\ \text{kg}} * \frac{1000\ \text{L}}{\text{m}^3} * \frac{10^6\ \mu\text{L}}{\text{L}} * \frac{\text{kg}}{10^6\ \text{mg}} = \frac{201.1\ \mu\text{L}}{\text{L}}$$

4. ANALYSIS DATA TO BE INCLUDED IN THE RISK MANAGEMENT PLAN

Under 40 C.F.R. § 68.165(b), the Facility is required to submit certain data in the RMP for the worst-case and alternative release scenario. Following are the inputs needed for *RMP*eSubmit.*

4.1. WORST-CASE RELEASE SCENARIO

5.1a: Chemical Name: Ammonia (anhydrous)
5.1b. Percent Weight of Chemical (If in a mixture): 100.0
5.2 Physical State (storage): Liquid
5.3 Model used: SLAB
5.4 Scenario: 10 minute release of entire contents of tank
5.5 Quantity released: 8,500 lbs.
5.6 Release rate: 850 lbs/min
5.7 Release duration: 10 minutes
5.8 Wind speed: 1.5 m/sec
5.9 Atmospheric Stability Class: F
5.10 Topography: Surface Roughness = 0.1 m
5.11 Distance to Endpoint: 2.17 miles
5.12 Estimated residential population within distance to endpoint: 250
5.13 Public receptors within distance to endpoint:
- a. Schools: No
- b. Residences: Yes
- c. Hospitals: No
- d. Prisons/Correction facilities: No
- e. Recreation areas: No
- f. Major commercial, office, or industrial areas: Yes
- g. Other (Specify): No

5.14 Environmental receptors within distance to endpoint:
- a. National or state parks, forests, or monuments: No
- b. Officially designated wildlife sanctuaries, preserves, or refuges: No
- c. Federal wilderness areas: No
- d. Other (Specify): No

5.15 Passive mitigation considered:
- a. Dikes: No
- b. Enclosures: No
- c. Berms: No
- d. Drains: No
- e. Sumps: No
- f. Other (Specify): No

4.2. ALTERNATIVE RELEASE SCENARIO

5.1a. Chemical name: Ammonia (anhydrous)
5.1b. Percent Weight of Chemical (If in a mixture): 100.0
5.2 Physical State (storage): Liquid

5.3 Model used: SLAB
5.4 Description Flex hose crack or release during ammonia loading
5.5 Quantity released: 2,460 lbs
5.6 Release rate: 492.0 lbs/min
5.7 Release duration: 5 min
5.8 Wind speed: 3 m/sec
5.9 Atmospheric Stability Class: D
5.10 Topography: Rural
5.11 Distance to Endpoint: 0.56 miles
5.12 Estimated residential population within distance to endpoint: 60
5.13 Public receptors within distance to endpoint:
   a. Schools: No
   b. Residences: Yes
   c. Hospitals: No
   d. Prisons/Correction facilities: No
   e. Recreation areas: No
   f. Major commercial, office, or industrial areas: Yes
   g. Other (Specify): No
5.14 Environmental receptors within distance to endpoint:
   a. National or state parks, forests, or monuments: No
   b. Officially designated wildlife sanctuaries, preserves, or refuges: No
   c. Federal wilderness areas: No
   d. Other (Specify): No
5.15 Passive mitigation considered:
   a. Dikes: No
   b. Enclosures: No
   c. Berms: No
   d. Drains: No
   e. Sumps: No
   f. Other (Specify): No
5.16 Active mitigation considered:
   a. Sprinkler systems: No
   b. Deluge System: No
   c. Water curtain: No
   d. Neutralization: No
   e. Excess flow valve: No
   f. Flares: No
   g. Scrubbers: No
   h. Emergency shutdown systems: Yes
   i. Other (specify): No

APPENDIX A: SLAB MODEL PARAMETERS

Worst-Case Release Scenario
LCS
Watford City, North Dakota

Date/time		
Date	7/1/2013	
Local Time	12:00	PM

Coordinate System		
Projection	UTM	
Datum	NAD83	
UTM Zone	13	N

Chemical	
Ammonia (anhydrous)	
Parameters:	Standard

Levels of concern		
LOC type	Toxicity	
Lower	Toxic End Pt (201.134 ppm)	
Middle	-	
Upper	-	
Avg. Time[1]	10	Min

1. Model Averaging time taken as 10 minutes per U.S. EPA "Risk Management Program Guidance for Offsite Consequence Analysis", EPA 550-B-99-009, March 2009.

Meteorology		
Temperature[1]	100	F
Pressure	760	mmHg
Relative humidity[2]	65.7	%
Wind direction	180	degrees
Wind speed[2]	1.5	m/s
Anemometer height	10	meters
Stability class[2]	F	
Surface roughness[3]	0.1	meters

Year	Average Dew Point Temp. (F)	Mean Temperature (F)	Maximum Temperature (F)	Average Humidity[4] (%)
2010	31	41	97	67.3
2011	32	42	99	67.4
2012	32	44	100	62.5
3 yr Average	-	-		65.7

1. The maximum daily temperature was chosen from past 3 years of data, per guidance from 40 CFR 68.22(b) for worst case, taken from http://www.wunderground.com/history/airport/KISN/. Weather station KS25 for Watford City, ND did not offer complete meteorological data for the last 3 years (2010-2012).

2. Humidity taken as average over past 3 years of data, and wind speed and stability class chosen for worst case per guidance from 40 CFR 68.22(b) and (c).

3. Surface roughness factor was chosen to be 0.1 m, corresponding to rural (Grasslands/Herbacious/ Low Crops) topography, per guidance from 40 CFR 68.22(e) and EPA's AERSURFACE Userguide (http://www.epa.gov/scram001/7thconf/aermod/aersurface_userguide.pdf).

4. Humidity data from http://www.wunderground.com/history/airport/KISN/
Average humidity data calculated from yearly average dewpoint and yearly mean temperature using psychometric chart (tool: http://andrew.rsmas.miami.edu/bmcnoldy/Humidity.html)

Worst-Case Release Scenario
LCS
Watford City, North Dakota

Source Type	Tank
Release Point Latitude	47.7967
Release Point Longitude	-103.5773

Two storage tanks interconnected for equalization.

Tank 1 Dimensions		
Type	Horizontal	
Height[1]	14.66	ft
Diameter	5	ft
Tank Above Ground Level[1]	0.00	m
Volume	2,000	gallon

1. Per 40 CFR 68.22(d), you must assume a ground level release. Actual tank height above ground level is 2.03 meters.

Diking Area	698.7	sq. ft.
Dike Height	1.1	ft

Diking Area can be estimated from site drawings.

Average Ground Cover Surrounding Tank (gravel, earth, grass?)	Gravel

Storage Conditions		
Temperature[2]	105	F
Storage Pressure[2]	215	psia
Total Mass[3]	8,500	lbs

2. When the system is not running, the ammonia would assume ambient temperatures and corresponding vapor pressure. When the system is running, the vaporizing heaters shutdown at 105 F and 215 psig.

3. Tank maximum capacity is 85% of total volume of 10,000 lbs per 8/13 email from Joe Fiedler.

Release Characteristics[1]		
Orientation	Horizontal	
Height	0	ft
Diameter of Hole[2]	1.06	in
Duration	10	min
Release Rate	850	lb/min

1. Worst case release characteristics chosen as a horizontal release nearest the ground from a hole, allowing the SLAB model to release all contents continuously for 10 minutes.

2. Diameter of the hole was chosen to allow the release of all contents over 10 minute span.

Model Output		
Radius of impact	137,319	in
Radius of impact	2.17	miles

Alternative Release Scenario
LCS
Watford City, North Dakota

Date/time		
Date	7/1/2013	
Local Time	12:00	PM

Coordinate System		
Projection	UTM	
Datum	NAD83	
UTM Zone	13	N

Chemical	
Ammonia (anhydrous)	
Parameters:	Standard

Levels of concern		
LOC type	Toxicity	
Lower	Toxic End Pt (201.134 ppm)	
Middle	-	
Upper	-	
Avg. Time[1]	10	Min

1. Model Averaging time taken as 10 minutes per U.S. EPA "Risk Management Program Guidance for Offsite Consequence Analysis", EPA 550-B-99-009, March 2009.

Meteorology		
Temperature[1]	42.3	F
Pressure	760	mmHg
Relative humidity[2]	65.7	%
Wind direction	180	degrees
Wind speed[2]	3	m/s
Anemometer height	10	meters
Stability class[2]	D	
Surface roughness[3]	0.1	meters

Year	Average Dew Point Temp. (F)	Mean Temperature (F)	Maximum Temperature (F)	Average Humidity[4] (%)
2010	31	41	97	67.3
2011	32	42	99	67.4
2012	32	44	100	62.5
3 yr Average	-	-		65.7

1. The average daily temperature was chosen from past 3 years of data, per guidance from 40 CFR 68.22(b) for alternative case, taken from http://www.wunderground.com/history/airport/KISN/

2. Humidity taken as average over past 3 years of data, and wind speed and stability class chosen for alternative release case per guidance from 40 CFR 68.22(b) and (c).

3. Surface roughness factor was chosen to be 0.1 m, corresponding to rural (Grasslands/Herbacious/ Low Crops) topography, per guidance from 40 CFR 68.22(e) and EPA's AERSURFACE Userguide (http://www.epa.gov/scram001/7thconf/aermod/aersurface_userguide.pdf).

4. Humidity data from http://www.wunderground.com/history/airport/KISN/
Average humidity data calculated from yearly average dewpoint and yearly mean temperature using psychometric chart (tool: http://andrew.rsmas.miami.edu/bmcnoldy/Humidity.html)

Alternative Release Scenario
LCS
Watford City, North Dakota

Source Type	Pipe

Pipeline Dimensions		
Length	20.00	ft
Diameter	6	in
Pipe Above Ground Level[1]	4.00	ft

1. Based on images of liquid fill location.

Diking Area	698.7	sq. ft.
Dike Height	1.1	ft

Diking Area can be estimated from site drawings.

Average Ground Cover Surrounding Tank (gravel, earth, grass?)

Ammonia Conditions		
Temperature	42.3	F
Storage Pressure	75.913	psia

Release Characteristics[1]		
Area of Release[1]	1.570	in
Liquid Flow Rate	571	lb/min
Duration	5	min
Mass Released	2,460	lb
Release Rate (Calculated)	492.0	lb/min

1. Area of the release was taken as half of the flex hose tube end area simulating a crack.

Model Output		
Radius of impact	35,429	in
Radius of impact	0.56	miles