

**ENCLOSURE 1
ATTACHMENT 1**

SHINE MEDICAL TECHNOLOGIES, INC.

**SHINE MEDICAL TECHNOLOGIES, INC. APPLICATION FOR CONSTRUCTION PERMIT
PRELIMINARY SAFETY ANALYSIS REPORT REVISIONS**

**UPDATE TO THE EVALUATION OF AIRCRAFT HAZARD AND THE EVALUATION OF
CHEMICAL HAZARDS PROVIDED IN THE PRELIMINARY SAFETY ANALYSIS REPORT**

**PRELIMINARY SAFETY ANALYSIS REPORT CHANGES
(MARK-UP)**

- Airports
 - Southern Wisconsin Regional Airport
 - Mercy Hospital Heliport
- Airways
 - Federal Airway ~~V9-177~~V24-97
 - Federal Airway V63

In addition, an investigation of industrial, military, and transportation facilities beyond 8 km (5 mi.) from the SHINE site identified the following significant transportation facilities and routes for further evaluation:

- Airports
 - Beloit Memorial Hospital Heliport
 - Hacklander Airport
 - Melin Farms Airport
 - Archie's Seaplane Base
 - Beloit Airport
 - Turtle Airport
- Airways
 - Jetway Route J-90
 - Federal Airway ~~V-63~~V9-63-128
 - Federal Airway V9-177
 - Federal Airway V24
 - Federal Airway V97
 - Federal Airway V-177
 - Federal Airway V-216
 - Federal Airway V246

Figure 2.2-1 shows the location of the industrial and transportation facilities, with the exception of airways, identified within 8 km (5 mi.) of the SHINE site. Figure 2.2-2 illustrates the airports, jet routes, and airway routes identified within 16 km (10 mi.) of the SHINE site.

2.2.1.1 Descriptions

Descriptions of the industrial and transportation facilities, with the exception of airports and airways, identified within 8 km (5 mi.) of the project site are provided in the following subsections. Airports and airways are described in Subsection 2.2.2.

2.2.1.1.1 Industrial Facilities

Six existing industrial facilities are identified in Subsection 2.2.1. Table 2.2-1 provides a concise description of these facilities, including their primary functions and major products, as well as the number of persons employed.

In addition, a detailed analysis of the potential hazards to the SHINE facility due to chemical storage both on and off the project site is presented in Subsection 2.2.3

2.2.1.1.2 Pipelines

Several natural gas distribution pipelines are located within 8 km (5 mi.) of the project site as depicted in Figure 2.2-1. Available information about these pipelines is included in Table 2.2-3 and summarized below.

Union Pacific. The chemicals transported on the nearest railroad are analyzed in Subsection 2.2.3.

2.2.1.1.6 Projections of Industrial Growth

Overall, a small percentage of Rock County is industrial, with the majority of industries in the larger cities of Janesville and Beloit. The only planned industrial growth identified within 8 km (5 mi.) of the SHINE site is expansion of the Southern Wisconsin Regional Airport. The airport plans on expanding runways away from US 51. The airport operations are not expected to grow significantly (Burdick, 2012a). The Janesville and Beloit Comprehensive Plans do not provide details of any planned industrial growth (City of Beloit, 2012; City of Janesville, 2012a).

2.2.2 AIR TRAFFIC

2.2.2.1 Airports

Table 2.2-5 provides a list of airports within 10 mi. (16 km) of the site. The Mercy Hospital Heliport and the Southern Wisconsin Regional Airport are the only airports within 5 mi. (8 km). None of the airports between 5 mi. (8 km) and 10 mi. (16 km) have a number of annual aircraft operations greater than 200d² (where d is the distance to the SHINE facility in kilometers). The hazards, associated with the Mercy Hospital Heliport and the Southern Wisconsin Regional Airport, are evaluated in Subsection 2.2.2.5.2. Figure 2.2-2 identifies the airports within 10 mi. (16 km) of the SHINE facility.

2.2.2.2 Airways

There are ~~nine~~10 federal airways, including one jetway, located within 10 mi. (16 km) of the SHINE facility (distance from the center of the SHINE facility to the nearest edge of the airway). These airways are identified in Table 2.2-6. NUREG-1537 states that "Factors such as frequency and type of aircraft movement, flight patterns, local meteorology, and topography should be considered..." However the document does not provide a screening criterion for the distance of the airways from the SHINE facility. Therefore, NUREG-0800, Standard Review Plan (SRP), Subsection 3.5.1.6 was used to provide guidance in evaluating airways near the SHINE facility. For airways where the outer edge of the airway is greater than two statute miles from the SHINE facility, SRP Subsection 3.5.1.6 allows the airway to be screened out with no further evaluation. ~~There are four airways (V177, V63, V9-177, and J90) where the edge of the airway is within~~ Each of the 10 federal airways located within 10 mi. (16 km) of the SHINE facility was identified as having an edge of the airway within two statute miles of the SHINE facility (see Table 2.2-6). The hazards associated with these airways are evaluated in Subsection 2.2.2.5.1. Figure 2.2-2 identifies the centerline of federal airways within 10 mi. (16 km) of the SHINE facility.

2.2.2.3 Military Airports and Training Routes

There are no military airports or training routes located within 10 mi. (16 km) of the SHINE facility. The closest military training route is SR771. The centerline of this training route is greater than 25 mi. (40 km) from the SHINE facility. This distance is greater than the 5 mi. (8 km) screening criteria in SRP Subsection 3.5.1.6.

2.2.3.1.1.3 Highways

Table 2.2-16 includes the hazardous materials potentially transported on US 51 and I-90/39. The materials that were identified as the bounding chemicals for explosive potential were diesel, ethylene oxide, gasoline, and propane on US 51, and hydrogen on I-90/39. The remaining chemicals are either non-explosive (chlorine, sulfur dioxide, and nitric acid) or are bounded based on the comparison method discussed in Subsection 2.2.3.1.1 (ammonia, propylene oxide, and styrene). The maximum quantity of the identified chemicals assumed to be transported on the roadway was 50,000 pounds (lb.) (22,679 kilograms [kg]) per Regulatory Guide 1.91, except for the hydrogen, where at most 3300 lb. (1496 kg) is on a single truck per 49 CFR 173.318.

An analysis of the identified chemicals was conducted using TNT equivalency methodologies, as described in Subsection 2.2.3.1.1. The results indicate that the minimum separation distances (i.e., safe standoff distances) are less than the shortest distance to a safety-related SHINE structure from any point on US 51 or I-90/39. A tank of diesel that contains 1,258,091 lb. (570,660 kg) of diesel is acceptable at 0.22 mi. (0.35 km). A tank of ethylene oxide that contains 440,000 lb. (199,580 kg) of ethylene oxide is acceptable at 0.22 mi. (0.35 km). A tank of gasoline that contains 133,946 lb. (60,756 kg) is acceptable at 0.22 mi. (0.35 km). A tank of jet fuel containing 500,000 lb. (226,796 kg) is acceptable at 0.22 mi. (0.35 km). A tank of propane that contains 55,724 lb. (25,275 kg) is acceptable at 0.22 mi. (0.35 km). The closest safety-related SHINE area is located approximately 0.22 mi. (0.35 km) from US 51.

The propane truck was also analyzed for a BLEVE overpressure. The standoff distance to a 1 psid (6.9 kPa) overpressure is 332 ft. (101 m). This is much less than the actual distance from US 51 to the SHINE facility, 0.22 mi. (0.35 km).

A tank containing 18,196 lb. (8253 kg) of hydrogen is acceptable at a distance of 0.22 mi. (0.35 km). The closest safety-related SHINE area is 2.1 mi. (3.4 km) from I-90/39.

The limiting stationary explosions are shown in Table 2.2-17.

Based on the above, an explosion involving potentially transported hazardous materials on US 51 or I-90/39, would not adversely affect operation of SHINE.

2.2.3.1.1.4 On-Site Chemicals

[SHINE will use electric forklifts. Therefore, propane was not identified as a potential on-site explosive hazard.](#)

On-site stationary chemicals were analyzed using the TNT equivalency methodologies, as described in Subsection 2.2.3.1.1. ~~Four~~Three chemicals were identified as being potential explosive hazards on-site: deuterium/tritium, diesel oil, ~~propane~~, and n-dodecane. One chemical, nitrogen, was analyzed for a BLEVE.

The deuterium and tritium are used in the production facility and are treated for this analysis as hydrogen gas. For both chemicals, the maximum expected mass in one container is between 0.4 lbs and 0.25 lbs (0.18 kg and 0.11 kg). This is a very low mass, however, because these chemicals are used in production, there is no separation between the hazard and the SHINE safety-related structures and areas. The deuterium and tritium gas systems and processes are designed to minimize the probability of an explosion. With safety features, and the very small mass of each chemical, the probability of an explosion causing enough damage to the facility to cause a radiological release to the public is low.

The on-site diesel explosion is analyzed using a probabilistic analysis. The total probability of a significant explosion is estimated using the probability of a spill and the conditional probability of an explosion given a spill. The probability of a large release from a single walled stationary tank at a fixed facility is 1×10^{-5} spills per year and the probability of a spill from a double walled stationary tank is 1×10^{-6} spills per year (FEMA, 1989). The rate of explosions per spill from diesel tanks is very low. A report on ignition probabilities for oil and gas states that for releases of “combustible liquids stored at ambient pressure and at temperatures below their flash point from onshore outdoor storage area” tanks, the ignition probability is at most 0.24 percent. Combined with the single walled tank spill probability, the frequency of an ignition is 2.4×10^{-8} ignitions per year, significantly less than the acceptance criteria.

The on-site diesel explosion probability is also examined qualitatively. First, diesel is not very explosive. The flash point is greater than 100 degrees Fahrenheit ($^{\circ}\text{F}$) (38 degrees Celsius [$^{\circ}\text{C}$]). This means that any liquid or vapor has to be greater than 100°F (38°C) in order to cause ignition. This is unlikely to occur under normal conditions. Second, the diesel tank is buried. This reduces the likelihood of events that might cause the diesel tank to rupture or explode. For example, a buried tank is less likely to be run into by a vehicle on site. A buried tank is therefore more similar to a double walled tank than a single walled tank. With the probability analysis and the qualitative analysis, the probability of an explosion of the on site diesel tank is acceptably low.

The SHINE site standby diesel generator is tested monthly, so diesel refill trucks servicing the diesel tank are infrequent on-site. Due to the infrequency of such a condition, the associated hazards are small.

~~The on-site propane tanks are used as fuel for fork lifts in the Support Facility Building. The safe standoff distance to 1 psid (6.9 kPa) is 107 ft. (32.6 m), and the Support Facility Building is 115 ft. (35.1 m) from the Production Facility Building, where the safety-related areas are located. Therefore, a stationary explosion of the propane tanks used by the fork lifts is acceptable in the Support Facility Building.~~

~~In addition, a simple probabilistic analysis was performed to determine how often the propane fork trucks could be within 107 ft. (32.6 m). Based on an expected accident rate for the fork lifts, the propane tanks can be within 107 ft. (32.6 m) for an average of 1 hour a day (~350 hours per year). This allows some use of the propane fork lifts at the Production Facility Building.~~

The on-site n-dodecane is only stored in at most 55 gallon drums. The maximum amount of vapor in the tank is only 0.16 lbs (0.07 kg). This mass is considered negligible.

Failure of the on-site liquid nitrogen tank may cause a BLEVE overpressure on plant structures. The safe standoff distance for the BLEVE explosion is 194 ft. (59.1 m). The on-site nitrogen tank is located at least 200 ft. (61 m) from the nearest SHINE safety-related building.

Therefore, an explosion of any of these chemicals would not adversely affect operation of SHINE.

2.2.3.1.1.5 Nearby Facilities and Railways

There are three additional off-site facilities and railways that have explosive chemicals that are identified as the bounding instances of explosion analysis. The hazardous materials stored at

contents. There are a total of 404 allowable shipments per year of propane on US 51 past SHINE.

Though the annual number of shipments is unknown, this expected shipment frequency is acceptable for the following reasons. First, there are no instances of propane listed in the tier II reports for any facility within 5 mi. (8 km) of the SHINE facility. This would mean that the local usage of propane will be residential or to local farms, and is less likely to require a 50,000 lb. (22,679 kg) truck delivery. Second, there are large propane facilities on all sides of the SHINE facility, in Janesville, Milton, and Beloit, Wisconsin. Those that are distributors are likely to distribute to locations nearer to them, which limits the expected number of trucks that travel between Janesville and Beloit, Wisconsin. These facilities are also expected to get their deliveries from I-90/39, as opposed to US 51. Propane trucks on I-90/39 (distance of 2.1 mi. [3.4 km]) are acceptable based on the results presented above. Therefore, it is expected that the number of shipments of 50,000 lb. (22,679 kg) of propane down US 51 is less than 404 per year.

The results of flammable vapor cloud ignition and explosion analyses are summarized in Table 2.2-18.

2.2.3.1.2.4 On-Site Chemicals

On-site chemicals are also analyzed for flammable vapor cloud explosions. The only on-site chemicals that ~~were~~was analyzed for a flammable vapor cloud were the deuterium/tritium cylinders ~~and the propane fork lift tanks~~.

[SHINE will use electric forklifts. Therefore, propane was not analyzed for a flammable vapor cloud explosion.](#)

~~As described previously in Subsection 2.2.3.1.2, the ALOHA dispersion model was used to determine the distance a vapor cloud can travel before reaching the LEL boundary (i.e., the point at which the vapor cloud is no longer explosive) once a vapor cloud has formed from release of the identified chemical. The standoff distance to the LEL for propane was determined to be less than 107 ft. (32.6 m). Therefore, the stationary propane explosion is bounding over the flammable vapor cloud explosion.~~

The bounding amount of deuterium/tritium at risk in one IU cell is roughly 1375 standard liters. At the LEL for hydrogen, 4 percent, this corresponds to a volume of 1200 ft³ (34 cubic meters [m³]). The IU cells containing these gases are larger than these volumes, therefore, a detonation explosion inside the facility is not expected. The IU cells containing these gases are larger than these volumes, therefore, a detonation explosion inside the facility is not expected.

The results of flammable vapor cloud ignition and explosion analyses are summarized in Table 2.2-18.

2.2.3.1.2.5 Nearby Facilities and Railways

There are three additional off-site facilities and railways that store explosive chemicals that are identified for further analysis. The hazardous materials stored at nearby facilities that were identified for further analysis with regard to explosive potential are gasoline stored at Janesville Jet Center, ethylene oxide at Abitec, and methyl chloride and n-butyl alcohol at Evonik Goldschmidt. In addition, the methyl chloride and ethylene oxide are transported on the Union Pacific Railway. The methodology presented previously in Subsection 2.2.3.1.2 was used for determining the standoff distance for vapor cloud ignition and delayed vapor cloud explosion.

Table 2.2-6 Federal Airways within Ten Mi. (16 Km) of the SHINE Facility

Airway	Distance from Airway Centerline to SHINE Site (mi) ^(a)	Airway Width (mi.) ^(a)	Distance from Airway Edge to Center of SHINE Facility (mi.) ^{(a)(c)}
V177	5.8 <u>6.1</u>	9.2	4.2 <u>1.5</u>
V24-97	10.5 <u>4.5</u>	9.2	5.9 <u>(b)</u>
V216	6.9 <u>6.1</u>	9.2	2.3 <u>1.5</u>
V63	5.3 <u>0.5</u>	9.2	0.7 <u>(b)</u>
V9-177	4.8 <u>5.1</u>	9.2	0.2 <u>0.5</u>
V97	12.4 <u>6.1</u>	9.2	7.8 <u>1.5</u>
V24	11.6 <u>6.1</u>	9.2	7 <u>1.5</u>
V9-63-128	10.9 <u>6.1</u>	9.2	6.3 <u>1.5</u>
<u>V246</u>	<u>6.1</u>	<u>9.2</u>	<u>1.5</u>
J90	5.5	11.5	(b)

a) Statute miles.

b) The SHINE facility is within the airway width.

c) To calculate the distance from an airway edge to the center of the SHINE facility, the airway edge was assumed to extend one-half of a standard airway width in all directions from the airway centerline, including past the termination of an airway at a navigational aid.

Table 2.2-16 Bounding Explosive Chemical Hazards within 5 Mi. (8 Km) of the Project Site

Chemical	Location	Distance	Mass/ Volume	Explosion Type
Diesel Fuel	Bounding Instance	0.5 mi.	1,258,091 lbs	Stationary
Ethylene Oxide	Abitec / Rail	1.6 mi.	440,000 lbs	Stationary, Vapor Cloud
Gasoline	Janesville Jet Center	0.9 mi.	133,946 lbs	Stationary, Vapor Cloud
Jet Fuel (Kerosene)	Bounding Instance	0.22 mi.	79,968 lbs	Stationary
Methylchloride	Evonik / Rail	1.6 mi.	320,000 lbs	Vapor Cloud
N-Butyl Alcohol	Evonik Goldschmidt	3 mi.	25,160 lbs	Vapor Cloud
Deuterium/Tritium	On-site	N/A	1375 standard liters	Stationary, Vapor Cloud
Diesel Oil	On-site	50 ft.	22,248 gallons	Stationary
Nitrogen BLEVE	On-site	200 ft.	20,000 lbs	BLEVE
Propane	On-site	415 ft.	43.5 lbs (one tank)	Stationary, Vapor Cloud
Diesel Fuel	Truck (Highway 51)	0.22 mi.	50,000 lbs	Stationary
Ethylene Oxide	Truck (Highway 51)	0.22 mi.	50,000 lbs	Stationary, Vapor Cloud
Gasoline	Truck (Highway 51)	0.22 mi.	50,000 lbs	Stationary, Vapor Cloud
Propane	Truck (Highway 51)	0.22 mi.	50,000 lbs	Stationary, Vapor Cloud, BLEVE
Hydrogen	Truck (I-90/39)	2.1 mi.	3,300 lbs	Stationary, Vapor Cloud
Natural Gas (Methane)	Pipeline (West of Hwy 51)	0.28 mi.	NA	Vapor Cloud
Natural Gas (Methane)	Pipeline (East of I90/39)	2.5 mi.	NA	Vapor Cloud

References:

Abitec Corporation, 2012.

Crop Production Services, 2012.

Evonik Industries, 2012.

Manta, 2012(a-d).

Rock County, 2012.

Table 2.2-17 Stationary Explosion Analysis

Chemical	Location	Distance	Mass/ Volume	Acceptable Instance^(a)
Diesel Fuel	Bounding Instance	0.5 mi.	1,258,091 lbs	1,258,091 lbs at 0.22 mi.
Ethylene Oxide	Abitec / Rail	1.6 mi.	440,000 lbs	440,000 lbs at 0.22 mi.
Gasoline	Janesville Jet Center	0.9 mi.	133,946 lbs	133,946 lbs at 0.22 mi.
Jet Fuel (Kerosene)	Bounding Instance	0.22 mi.	79,968 lbs	500,000 lbs at 0.22 mi.
Deuterium/Tritium	On-site	N/A	1000 standard liters / 100 grams	Low probability - Safety features are designed into systems
Diesel Oil	On-site	50 ft.	22,248 gallons	Probability = 2.4×10^{-8} per year
Nitrogen BLEVE	On-site	200 ft.	20,000 lbs	20,000 lbs at 194 ft.
Propane	On-site	115 ft.	43.5 lbs (one tank)	43.5 lbs at 107 ft.
Diesel Fuel	Truck (Highway 51)	0.22 mi.	50,000 lbs	1,258,091 lbs at 0.22 mi.
Ethylene Oxide	Truck (Highway 51)	0.22 mi.	50,000 lbs	440,000 lbs at 0.22 mi.
Gasoline	Truck (Highway 51)	0.22 mi.	50,000 lbs	133,946 lbs at 0.22 mi.
Propane	Truck (Highway 51)	0.22 mi.	50,000 lbs	55,724 lbs at 0.22 mi.
Propane BLEVE	Truck (Highway 51)	0.22 mi.	50,000 lbs	50,000 lbs at 0.22 mi.
Hydrogen	Truck (I-90/39)	2.1 mi.	3,300 lbs	18,196 lbs at 0.22 mi.

a) The Acceptable Instance shows the analyzed condition that bounds the hazard in both distance and mass. For some chemicals, the maximum acceptable mass was calculated at the actual distance, for others the minimum standoff distance for the actual mass was calculated. This was performed to simplify the analysis. For example, the truck of diesel and the stored tank of diesel were combined into one bounding acceptable instance.

Table 2.2-18 Flammable Vapor Cloud Explosion Analysis

Chemical	Location	Distance	Mass/ Volume	Acceptable (Standoff Distance)
Ethylene Oxide	Abitec / Rail	1.6 mi.	440,000 lbs	0.54 mi.
Gasoline	Janesville Jet Center	0.9 mi.	133,946 lbs	0.36 mi.
Methylchloride	Evonik / Rail	1.6 mi.	320,000 lbs	0.24 miles
N-Butyl Alcohol	Evonik Goldschmidt	3 mi.	25,160 lbs	Vapor Pressure < LEL, no flammable vapor cloud
Deuterium/Tritium	On-site	N/A	1000 standard liters / 100 grams	Volume of vapor at LEL < volume of room, not confined
Propane	On-site	115-ft.	43.5 lbs (one tank)	107-ft.
Ethylene Oxide	Truck (Highway 51)	0.22 mi.	50,000 lbs	99 allowable shipments, few expected.
Gasoline	Truck (Highway 51)	0.22 mi.	50,000 lbs	0.214 mi.
Propane	Truck (Highway 51)	0.22 mi.	50,000 lbs	404 allowable shipments
Hydrogen	Truck (I-90/39)	2.1 mi.	3,300 lbs	0.77 mi.
Natural Gas (Methane)	Pipeline (West of Hwy 51)	0.28 mi.	NA	0.24 mi.
Natural Gas (Methane)	Pipeline (East of I90/39)	2.5 mi.	NA	2.2 mi.
Natural Gas (Methane)	Pipeline (Feeding SHINE)	NA	NA	Probability = 7.7×10^{-7} per year

Figure 2.2-2 – Airports and Airway Centerlines within 10 Mi. (16 Km) of the SHINE Facility



