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Dept. of Planning and Infrastructure
GPO Box 39
SYDNEY 2001
Attention: Andrew Hartcher – Planner

Reference: SSD-5119. Proposal for **Crawfords Freightlines Ammonium Nitrate Storage Facility**

27th February 2012

Dear Andrew,

This is a submission objecting to Crawfords Freightlines application for Ammonium Nitrate Storage facility at 158 Maitland Rd Sandgate 2304, a suburb of Newcastle.
I have many concerns about this proposed project. Those concerns include:

1. failure by the applicant to address requirements of AS4326 (The storage and handling of oxidising agents),
2. an underestimation on the risk from contamination and accidental blast in their storage area.
3. the potential for pollution to the wetlands area and,
4. the dangers to the health and safety of nearby residents

I share all the concerns you will receive from residents and other concerned citizens of the surrounding suburbs, and believe those concerns require the full attention of all government bodies.
My expertise is in Ammonium Nitrate (AN) as an explosive, and it is my concerns in that area where I will devote the bulk of my objections to Crawfords' proposal.
I have, at different times, held the record for the biggest open-cut blast, and the biggest underground mining blast in Australia. Indeed I have managed hundreds of million tonne rock blasts over my time in the mining industry as a Manager and Designer of blasting operations for Goldsworthy Mining, MIM Holdings, BHP, Thiess Bros and Orica.
I accept that AN, without additives, is just an oxidising agent. However, a 1tonne bag of AN can more easily be turned into an explosive (fuel oil, plus a detonator and booster) than a fertiliser, (thousands of litres of water – well mixed) which is its other main purpose.
I commence with that fact to dispel any fallacies about how inert AN may be as a product.

Apart from the nuclear tests carried out at Maralinga, the biggest blast in Australia's history was at the South Humphrey Iron Ore mine in WA in July 09 where 2.1 kltonnes of emulsion was used to blast 4 million tonnes of solid iron ore from the ground. The AN equivalent to that emulsion would require 2,560 tonnes. The important point from that fact is the much smaller quantity of AN required to create the biggest non-nuclear blast in Australia's history than is expected to be stored by Crawfords (13,500 tonnes) in their facility.

Putting that in some perspective, the worst industrial accident in US history only involved 2,300 tonnes of Ammonium Nitrate. It happened on April 16 in 1947 when a shipload of AN caught fire, apparently by spontaneous combustion, in a Texas port and exploded.
Deaths and injuries from the blast were counted in the thousands. Planes were knocked out of the sky, people were thrown to the ground 16km away in Galveston and windows were broken 60 km away in the main city of Houston.
A nearby ship, (moored 250m away) carrying ammonium nitrate, caught fire from the original blast and that AN cargo also exploded. The shock from the blast was felt 160km away in Louisiana.
Thousands of tonnes of ship's steel were hurled into the air at supersonic speeds. Ship's propellers and anchors that were thrown some km's inland are now on display as memorials at the entrance to Texas City.

Residents of Newcastle do not covet industrial accident memorials. Just a reminder that Crawfords intent is to store more than 5 times the AN volume involved in the Texas City incident.

The bomb that devastated Hiroshima at the end of WW2 was a 15klt blast, which makes it equivalent to 15,000 tonnes of TNT. That means to cause a blast of Hiroshima intensity an amount of around 18,000 tonnes of properly converted AN is sufficient.
However, Ammonium Nitrate, when not converted to a design explosive has a TNT equivalency of between 55% - 70% (the US military equivalency). That means 22,000 tonnes of AN would be required to produce a Hiroshima sized blast.
The relevance of those facts goes to Attachment 1 at the conclusion of this submission.
For AN to detonate it does NOT need to be properly mixed as an explosive. Attachment 1 shows just some of the accidents involving AN, sometimes in its crudest form as a powdered fertilizer, and sometimes in its prilled state, as will be stored by Crawfords. AN is more volatile in a prilled state as that configuration is designed to hold oxygen so that it may intensify the effect of any explosion.

All of those accidents in Attachment 1, causing thousands of deaths and injuries, billions of dollars in property damage, and destruction of entire communities are sober warnings of the dangers of AN being in close proximity to people. There is a further cautionary note relating to ALL of those accidents listed. NOT ONE of those accidents involved AN being properly mixed as an explosive. They all involved inadvertent contact between AN and some other catalyst, be it fire, fuel oil, impact, contamination, or in some disturbing results, as in Toulouse France in 2001, from unknown sources.

Using the accidents listed, and my knowledge of the potential for ignition of AN, some of the areas of concern for any plant and stockpile of AN include:

- Fire in a conveyor or fixed equipment, such as Crawfords' auger
- Fire in a piece of moving equipment, such as Crawfords' loaders or trucks or their forklifts
- Terrorist incursion
- Disgruntled employee or disturbed member of the public gaining access
- Lightning strike
- Earthquake

That list is not all inclusive. The potential for a risk of explosion should not be limited by the thoughts of any one person.
At full capacity Crawfords proposes 13,500 tonnes of AN stored permanently. Their EIS states at ***1.5.2 Receiving, Storage, Handling and Transportation,*** under **Product Distribution "**The number of trucks per day varies depending on when a shipment of product is received, approximately three to four vehicles per day is typical to meet customer requirements. The product is also distributed in bulk. Approximately five bulk trailers per day are distributed in this manner."

As required each truck would carry signs front and back showing the load to be classified as a Class 5.1 (Oxidising Agent). However if any truck is involved in a serious accident (roll over or fire) the load converts to a classification of 1.5 Explosive because of contamination by fuel oil, combustible material on the truck such as timber, plastic in truck wiring, or even the seating in the truck cab.
The ERG (Emergency Response Guidelines) dictate that a fire in contaminated AN is NOT to be fought and that evacuation is the correct response. Any fire-fighter will confirm their concerns about the dangers involved with fire on any truck with an AN load.
Indeed the truck accidents and consequent explosions and fatalities listed in Attachment 1 confirm those dangers.

Crawfords correctly note in their Volume II, Annex A – D 2 Section 16. MANAGEMENT SYSTEMS AND PLANS in Part *16.2 Emergency plan* "that any uncontrollable situation requires evacuation".

Crawfords have not provided a proper evacuation plan for the residents or visitors of the nearby Nursing Home, the residential areas, the Golf driving range, the highway running past their storage area, or the visitors to the cemetery as shown in their Figure ***1.4.3 Surrounding Land Uses***.

It is important to point out that whether accidental, or deliberate tampering with AN is performed, the intensity of any blast could have devastating consequences for the residents or visitors shown in Figure ***1.4.3 Surrounding Land Uses*** at positions 1, 6, 9, 5 and 7.
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A worst case scenario of a 13,500 tonne blast in the suburb of Sandgate is the destruction of the suburb with countless deaths and injuries.
However, any smaller accident that leads just to destruction of the storage plant has the potential to spread environmental contamination to the surrounding area. The suburbs of Newcastle could be exposed to clouds, extremely harmful to health, of Nitric Acid, Nitrogen Oxide, Ammonium gas, and Nitrogen Dioxide, just to name a few.

That brings to attention some specifics relating to the points listed at the start of this submission:

1. failure by the applicant to address requirements of AS4326 (The storage and handling of oxidising agents),

Crawfords EIS states a desire to store in Shed A a total of 4,500 tonnes of AN. Their proposal for Shed B is to store 3,500 tonnes indoors. They also state in their Proposal Overview at 1.3.2, that "Until late 2011 Impact Fertilisers Pty Ltd occupied Sheds A and B where they stored and distributed bulk fertiliser." As that fertilizer would have been a high density FGAN product, there is every likelihood that the timber walls of Sheds A and B were previously contaminated by AN dust. Although their EIS states that they intend to carry out "treatment of existing timber panelling to a height of 3 metres on the inside and outside of the buildings with reinforced concrete" it is possible that they are merely covering up already contaminated combustible material. If Crawfords are genuine in wanting to establish ALARP safety practice they would remove the timber walls and replace them with metal rather than cover them up.

Crawfords EIS states **"AS4326 Storage requirement (4.2.1)** • In stores where there is a risk of corrosion, electrical installations should have a rating of not less than IP 65."
Under their section *5.1 Buildings and storage areas* it also states "Existing electrical installations **are not** IP 65 rated". Although it goes on to say "no evidence of corrosion is apparent even after storage of ammonium nitrate in some sheds for several years", that is a statement that must be questioned. Part of Crawfords EIS states under ***4.5.2 Potential impacts "***Old style fluorescent lighting was observed during the survey...Identification of PCB Containing Capacitors database (1997) did not state either way whether the lights contain PCB. **These were unable to be assessed due to height restrictions** however, due to their age are considered to be likely to contain PCBs." The point of that quote is to question just how thorough the investigation into electrical contamination and corrosion was assessed in Sheds A, B and C? Was the ceiling electrical wiring to the lights in those sheds "**too high"** to check for contamination and/or corrosion? Plastic coating of electrical wiring is easily contaminated by AN. Failure to properly assess electrical wiring safety is a potential fire hazard.

Subclass 5.1 of the ADG Classification Code, while referring to Ammonium Nitrate, states: "*oxidising agents; substances which, although not necessarily combustible, may readily liberate oxygen, or be the cause of oxidisation processes. As a result they may start a fire in other materials or stimulate the combustion of other materials thereby increasing the violence of a fire."* The timber wall linings in Sheds A and B, and the electrical systems in Sheds A, B, and C, all listed for storage of AN in Crawfords' application may already be contaminated by the previous storage of both AN and other combustible products. Covering up possible contamination with shotcrete, or ignoring possible contamination because it is difficult to reach or check, is not a sufficient response to adhering to AS4326 (The storage and handling of oxidising agents).

The second point of concern is:

2. an underestimation on the risk from contamination and accidental blast in their storage area.

I have a real concern that Crawfords have been extremely conservative with the information in their EIS about the risk zone to persons and property from any accidental, or deliberate, blast from within their plant.
When Crawfords use the term 'conservative' they are referring to overestimating the dangers, where I refer to 'conservative' as a substantial underrating of the dangers.
Although Crawfords propose to store, as opposed to manufacture and store AN, it is a product that is easily contaminated and/or converted to an unstable state that lends itself to a possible catastrophic situation. Indeed, if I was preparing to blast 13,500 tonnes of properly prepared ANFO (AN mixed with fuel oil) in an industrial area, I would have an evacuation area greater than 10klm's. I take pride in having never injured a person or animal in any blast I was responsible for.

Ammonium Nitrate, when properly turned into an explosive, has a TNT equivalency of around 82%. The US military use 70% TNT equivalency for solid state ammonium nitrate.
The applicant has attempted to provide figures relating to 'Risk Analysis'. As stated in their Volume II, Annex A – D 2, Section15. ACHIEVING ALARP "The use of terms such as 'as low as reasonably practicable' (ALARP) or 'so far as is reasonably practicable' is a key concept in relation to the management of health and safety risks."
If Crawfords was genuine in wanting to show a commitment to proper "management of health and safety risks" to achieve safety standards that are "as low as reasonably practicable" they would use figures of TNT equivalency of 70% - 82%, and not the 5% - 32% as calculated in their application.

Crawfords' EIS at *9.1 Frequency – Explosion incident* states "Since 1918 there have been a total of eight (8) accidental explosions involving ammonium nitrate at storage facilities reported from around the world." They go on to say "Even reviews of more recent incidents (1991 to 2007) show that less than half of these are relevant to the Crawfords operations, and of these, more than half can be further eliminated as not credible – and none of these incidents resulted in explosion."
I am concerned that most of the 25 accidents, resulting in numerous deaths and injuries that are listed in Attachment 1 are considered by Crawfords to be "not relevant". They discount the truck accidents, the rail accidents, the transporting accidents involving AN as if they don't have trucks at their site, and they don't have rail movement of AN to their site; they treat their application as if they only store the product without any responsibility for its movement.
Please note that the two most common threads involving ALL the accidents listed in Attachment 1 are:

1. They did not consist of a properly mixed explosive use of AN. They happened unexpectedly without consideration of the often claimed need to turn the AN in to an explosive. They involved AN – held in a sometimes more stable format than Crawfords' stored product proposal – that had unpredictably became exposed to fire, contamination, impact or as mentioned, in Toulouse France in 2001, from unknown sources.
2. They all consisted of relatively small quantities of AN in comparison to what is expected to be stored at Crawfords Freightlines.

No Ammonium Nitrate accident, anywhere in the world, at any time, should ever be considered as 'not relevant' by Crawfords Freightlines, as part of an application for AN storage.
Further to the downplaying of previous accidents, Crawfords have provided risk assessments of hazards using spurious figures that are far too conservative to give a full picture of potential danger. They use stack quantities of 500 tonnes separated by just a few metres of distance.
Very few countries would allow AN stacks to be in excess of 300 tonnes. Although this quantity is not unlawful in Australia, it does go against many international standards.
In the UK, Ammonium Nitrate stack capacity is 300 tonnes. In the US the stack capacity is approximately 270 tonnes and in Canada the stack capacity is approximately 200 tonnes.

Any stack of 300 tonnes or more, of AN, is capable of creating its own momentum if exploded. A self-sustaining blast of a 13,500 tonne stockpile of AN would be disastrous for the Newcastle community. The point of those figures is that if Crawfords want to express a commitment to ALARP they would use world's best practice and reduce the stockpiles to 200 tonne or less.
Further to the quantity size of the stacks, there is a best practice commitment that should be allocated to the distances between the stacks.
In Crawfords' application at Volume ıı, Annex A – D 2 at **4.3.4** they refer to distances between stacks:
"The approach taken by Queensland, requiring 8 metres separation distances between stacks seems to be adopting the belief that larger separation distances than currently specified in Australian and overseas standards are required, but does not adopt the separation distances specified in the SAFEX document. Queensland information also suggests that the stack separation distance of 8 metres has been determined amongst Australian regulators, **and would be adopted in the 2008 version of AS 4326,** however this has not been the case. All other regulators, and AS 4326, currently require a stack separation of 3 metres."
Once again, any real commitment to ALARP would demand the calculations for risk analysis be at a design distance between stacks (even reduced to 200tonnes) of 8 metres – not 3 metres.

The third point of concern is:

3. the potential for pollution to the wetlands area

Crawfords' own application at 5. ENVIRONMENTAL ASSESSMENT states:
"Concentrations of Nitrogen (Total Oxidised) was reported above the laboratory limit of reporting in all sampling locations on site with the exception of one isolated location (BH05), located within the timber storage yard adjacent to the outdoor storage compound of Shed C. The highest reported concentrations were noted to be within the current outdoor AN storage compound south of Shed B, being MW02 (510 mg/kg) and MW04 (108mg/kg).
Analytical groundwater concentrations for Ammonia (as N) were consistently encountered at all locations across the site above the level of reporting. Elevated concentrations of ammonia were reported for MW02 (16,400µg/L) and MW04 (4,620µg/L) located within areas of current and historic AN storage areas. Following findings from the Phase 1 ERM report (2012), MW02 was installed to target reported historical spills associated with the former historical operations in Shed B."

They go on to point out some *Potential Impacts*
"The results of the investigation indicated that:
Elevated concentrations of ammonia and nitrogen in soil were encountered in areas of current and historic AN handling and storage. PAHs and metals were encountered in the fill material on site and are considered likely to be related to filling activities and not current or historic operations on the site; and elevated concentrations of ammonia and nitrogen were encountered in groundwater in areas of current and historic AN handling and storage.
Elevated concentrations of ammonia (as N) in groundwater are considered to be significant and warrant notification of the site under Section 60 of the CLM Act 1997. At this stage it is not considered that these elevated concentrations pose a risk to human health as it is highly unlikely that the groundwater is impacting on a drinking water source, however given the close proximity to surface water it is recommended that site practices are reviewed to minimise spillage of AN on the site and a programme of yearly groundwater monitoring be implemented across the site to assess ammonia and nitrogen concentrations and the effect of improvements on the management of AN."

Although water quality is not my field of expertise, it appears that the area has already been polluted to a degree that requires constant monitoring. Storage and handling of Ammonium Nitrate, in greater quantities than previously, will not reduce or lessen any potential pollution of groundwater to the health and safety of nearby residents.

The fourth point of concern is:

4. the dangers to the health and safety of nearby residents

Although each of the points above that make up this submission goes some way to addressing point 4, there are further considerations that require clarification or reinforcement.
Shed C that has so far escaped mention has its own issues of concern. Shed C is supposed to hold 3,500 tonnes indoors of Ammonium Nitrate.
As stated in the proposal Overview at 1.1.1, “Shed C... roof is lined with Asbestos and polycarbonate sheeting”. In case of any accident involving fire or explosion in Shed C, that asbestos can be expected to be spread over Sandgate and surrounding areas.
There are two other areas of concern not covered in the Crawfords application. The first is Shed D, that although their application states will not be used for storage of AN, it has previously been used to store general cargo that are high contaminants. Previously stored timber logs and aluminium ingots could easily provide combustible contaminants for AN. Aluminium dust would provide an extremely dangerous contaminant. Indeed I, and others, have previously added aluminium dust to AN to increase its explosive power. Crawfords’ application should be rejected AND additionally there should be a directive from NSW WorkCover specifically preventing AN storage in shed D at any time; now or in the future. The second area not covered is the use of wooden pallets. There is no mention anywhere of disposal of those pallets. Wooden pallets used for cartage or storage of AN should not be recycled because of possible contamination and combustibility. They should be destroyed.

Although an explosion from uncontaminated AN can usually be considered unlikely, the hazards associated, and recognised in Crawfords’ application for storage of AN, cannot be ignored.
The first of these hazards is fire. Any site fire from any source will be quickly enhanced by contact with AN. If a fire containing AN reaches a temperature of 170c the AN will become molten and extremely sensitive to impact and explosion.
The second hazard is decomposition. Ammonium nitrate can undergo thermal decomposition if it receives enough energy. At moderate temperature, the exothermic (a chemical reaction formed with the development of heat) decomposition is balanced by endothermic (a chemical reaction formed with the absorption of heat) dissociation. Provided the gases produced can escape freely and no heat is being added to the system (e.g. through a fire) a steady state is reached.
However, the decomposition can also become self-sustaining in the presence of contaminants, in the presence of combustible materials which generate heat as they are oxidised; or if the initial temperature is high enough. This self- sustained gas build up can result in an unexpected explosion.
The third hazard is from the explosion itself. When determining any industrial storage complex there must be a balance between risk and consequence. No matter how many ways figures can demonstrate ways to limit the possible risks from an explosion in the storage facility, the outcome suggests the consequences could be catastrophic to Sandgate residents, Newcastle, and any person in the vicinity of the storage area, visiting the golf range or cemetery.
Indeed this proposed storage application by Crawfords Freightlines should NOT be allowed.
As a submission maker, I can confirm that I have not made a political donation in the past two years.

Yours Sincerely,

A. A. Richards.

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ATTACHMENT 1

AMMONIUM NITRATE EXPLOSIONS

Bryan, TX, United States 2009
A plant in Bryan, TX (El Dorado Chemical Company) which processes ammonium nitrate into fertilizer caught fire at about 11:40 am on July 30, 2009. Over 80,000 residents in the Bryan/College Station area were asked to evacuate south of town due to the toxic fumes this fire generated. Texas A&M University provided shelter at Reed Arena, a local venue on campus. Only minor injuries were reported.

Monclova, Coahuila, Mexico 2007
A trailer loaded with 22 tons of ammonium nitrate crashed into a truck leaving three dead in the crash. A fire then started in the trailer's cabin. About 40 minutes later a huge explosion occurred, resulting in around 150 people injured and 37 more dead. A crater 9.1 m wide and 1.8 deep was created due to the explosion.

Estaca de Bares, Spain 2007
The NPK fertilizer cargo of the ship Ostedijk sustained a self sustained decomposition (SSD) fire for 11 days. The fire plume reached 10 m in diameter and several hundred meters in length. Special water spears were inserted inside the cargo to extinguish the fire.

Ryongchŏn, North Korea, 2004
A freight train carrying ammonium nitrate exploded, killing 162 people and injuring over 3,000 others. The train station was destroyed, as were most buildings within 500 metres, and nearly 8,000 homes were destroyed or damaged. It left two craters of about ten metres in depth.

Mihăileşti, Buzău, Romania, 2004
A truck carrying 20 tones of ammonium nitrate tipped over on the E85 road at 4.57AM. A fire started in the cabin. Around 5.50 AM the truck exploded, killing 18 and wounding 13 people. The explosion was heard 10klm away and formed a crater 6.5 meters deep and 42 meters in diameter.

Barracas, Spain 2004
A truck carrying 25 tonnes of ammonium nitrate fertilizer exploded after a traffic accident, killing two people and injuring three others. The explosion was heard 10 km away, and created a crater five metres deep.

Cartagena, Murcia, Spain 2003
The fertilizer storage facility of Fertiberia held a self sustained decomposition (SSD) fire in January 2003. The fire was controlled after most of the material was removed by mechanical means.

Toulouse, France 2001
On September 21, 2001, at 10:15 AM, in the AZF (factory) (Azote de France) fertiliser factory in Toulouse, France, an explosion occurred in a warehouse where the off-specification granular AN was stored flat, separated by partitions. About 200–300 tons is said to be involved in the explosion, resulting in 31 people dead and 2,442 injured, 34 of them seriously. The blast wave shattered windows up to 3 kilometres away and the resulting crater was 10 metres deep and 50 metres wide. The exact cause remains unknown. The material damage was estimated at 2.3 billion euros.

Port Neal, Iowa 1994
Two explosions at the Iowa ammonium nitrate processing plant killed four people and injured18 others. Approximately 5,700 tons of anhydrous ammonia was released. The releases of ammonia continued for six days after the explosions. Groundwater under the processing plant was contaminated by chemicals released as a result of the blast.

Papua New Guinea 1994
11 workers were killed when the sensitised AN emulsion plant exploded at the Porgera Gold Mine. The fatal explosion involved at most a few tonnes of explosive. A larger explosion of about 80 tonnes Ammonium Nitrate Emulsion was caused by fires under storage facilities at the site. There were no fatalities in the second explosion as the site had been evacuated. A mushroom cloud was seen to rise. ANE is an emulsion of ammonium nitrate, fuel and water.

Kansas City, Missouri **1988**
Two trailers containing approximately 23,000 kg of ammonium nitrate exploded at a construction site. At 4:07 AM one of the "magazines" of explosives caught fire and a catastrophic explosion occurred, killing six firemen instantly — only sparing remains were found. A second blast occurred 40 minutes later. The blasts created two craters, each approximately 30 m wide and 2.4 m deep. The explosions shattered windows within a 16 km area and could be heard 64 km away.
Taroom Qld **1974**
In 1974 in Taroom, Queensland, 2 tonnes of ammonium nitrate on a truck caught fire and exploded, killing three people.
Traskwood, Arkansas **1960**
On December 17, 1960, a 96 freightcar train suffered partial derailment in which the last 23 cars were derailed. The derailed cars included cars containing oil, liquid fertilizer, fuming nitric acid and fertilizer grade ammonium nitrate. The nitric acid reacted with the fuel oil, creating ANFO to feed the conflagration, resulting in the spread of the ammonium nitrate around the incident site.
Roseburg, Oregon **1959**
A truck carrying dynamite and ammonium nitrate caught fire early in the morning of August 7, 1959. When it exploded it killed 14 people and injured 125 more. Several blocks of downtown Roseburg were destroyed. The accident is locally referred to as "The Blast."
Red Sea **1954**
A fire was detected on the cargo ship Tirrenia while it was carrying 4000 tonnes of ammonium nitrate. Attempts to extinguish the fire were unsuccessful. The ship was abandoned and exploded later in the night.
Brest, France **1947**
The cargo ship Ocean Liberty was loaded with 3300 tonnes of ammonium nitrate and various inflammable products when it caught fire at 12:30 July 28, 1947. The vessel was towed out of the harbour at 14:00, and exploded at 17:00. The explosion caused 29 deaths and serious damage to the port of Brest.
Texas City, United States **1947**
The cargo ship Grandcamp was being loaded on April 16, 1947 when a fire was detected in the hold. 600 tonnes of ammonium nitrate in sacks were already aboard. The ship exploded, killing several hundred people and setting fire to another vessel, the High Flyer, which was moored 250 metres away and which contained 1050 tonnes of sulfur and 960 tons of ammonium nitrate. The Grandcamp explosion also created a powerful earthshock and knocked two small planes flying at 460 m out of the sky. The High Flyer exploded the next day, after having burned for sixteen hours. About 500 tonnes of ammonium nitrate on the quayside burned without exploding, probably because it was less tightly packed.
Tessenderlo, Belgium **1942**
Another attempt to disaggregate a pile of 150 tonnes of ammonium nitrate with industrial explosives ended tragically on April 29, 1942: several hundred people were killed.
Miramas, France **1940**
240 tonnes of ammonium nitrate in sacks exploded after being hit by a shell from fire in a munitions train.
Rouen, France **1940**
During a bombing raid on June 5, 1940, a bomb exploded in a warehouse containing ammonium nitrate: the fertilizer was dispersed around the crater, but did not explode.
Muscle Shoals, Alabama **1925**
Two carloads, each containing 220 barrels of ammonium nitrate, caught fire in transportation. The barrels had been stored in a warehouse with varying humidity for 6 years. It is believed that they were ignited by friction with their nitrate-impregnated manila paper lining.
Nixon, New Jersey **1924 (Now Edison Township)**
On March 1, 1924, a fire and several large explosions destroyed a warehouse containing ammonium nitrate at the Nixon Nitration Works.

Oppau, Germany 1921
An attempt at disaggregation of a fertilizer mix with industrial explosives caused the death of 450 people and the destruction of 700 houses. The fertilizer was a 50:50 mixture of ammonium nitrate and ammonium sulfate. The factory had used this method of disaggregation over 20,000 times without incident. Only 450 tonnes exploded. There were 4,500 tonnes of fertilizer stored at the warehouse.
Kriewald, Germany 1921
Workers tried to dislodge 30 tonnes of ammonium nitrate which had aggregated (solidified into one mass) in two wagons. When explosives were used on this solid mass the wagons exploded and killed nineteen people.
Morgan, New Jersey 1918 (Now Sayreville)
An explosion at the Morgan Depot occurred leading to many artillery shells being launched into the air, some of which landed on a neighbouring warehouse where 4000 tonnes of ammonium nitrate were stored in barrels. One of the shells caused a large explosion, but the majority of the ammonium nitrate did not detonate.