Incident Title	**Ammonium Nitrate Warehouse Explosion**	
Incident Type	Explosion	
Date	21st September 2001	
Country	France	
Location	Toulouse	
Fatalities	**Injuries**	**Cost**
31	2442	> €2.0 bn (2013) – Ref. 1

Incident Description

A huge explosion occurred approximately 20 minutes after a small quantity of sodium dichloroisocyanurate ($C_3Cl_2N_3NaO_3$ or "SDIC") was spilled onto a pile of off-specification ammonium nitrate (NH_4NO_3 or "AN") which had been stored in Shed 221 for recycling. The blast was equivalent to a magnitude 3.4 earthquake on the Richter scale (20 - 120 tonnes of AN detonated). Much of the plant was destroyed and significant escalation occurred (including a secondary explosion) at a neighbouring hazardous process plant owned by others. More than 1000 homes were rendered uninhabitable and many more were damaged. More than 82 schools were also damaged. Atmospheric pollutants released after the detonation of the AN included nitric acid (HNO_3), ammonia (NH_3), nitrogen dioxide (NO_2) and nitrous oxide (N_2O). A nitric acid plant at the site was also damaged, causing pollution of the River Garonne.

Incident Analysis

Basic cause was probably either chemical incompatibility or major electrical failure in an adjacent storage area (exact cause not determined). [SDIC additive reacts with AN to form explosively unstable nitrogen trichloride. Shed 221 was lit by natural light only but an electrical failure at an adjacent plant could have produced a massive electrical arc in the AN storage area.]

Critical factors included: 1) Shed 221 contained several different grades of AN which were off-spec. for chemical composition or grain size (adjacent sheds were used for packaging of various grades of AN products), 2) Shed 221 operations were managed by waste management subcontractors (potential for incomplete knowledge of hazards associated with AN handling and storage), 3) SDIC was accidentally spilled onto an off-spec. pile of AN during transfer to Shed 221, 4) Shed 221 floor was paved with bitumen (potential source of contamination which increases AN explosive sensitivity).

Root causes included: 1) Inadequate risk assessment (detonation had not been included as a credible scenario by the operating company, third party technical experts, or the regulator), 2) Failure to learn (from previous incidents involving fertiliser and other grades of AN), 3) Inadequate land use planning regulations (urbanisation of land adjacent to existing plant), 4) Inadequate regulatory oversight (off-spec. AN storage not regulated).

Lessons Learned

1) The ammonium nitrate (AN) inventory reporting threshold was reduced to broaden the applicability of the Seveso II Directive to include smaller plant, 2) Escalation impact studies should be carried out to inform plant design (eg. inventory control, plant layout, equipment spacing) and emergency response planning strategies, 3) AN should be stored in single storey, well-ventilated buildings constructed from non-combustible materials (eg. concrete, bricks or steel) and located away from potential sources of heat, fire or explosion, 4) Different grades of AN should be stored separately and their inventories minimised, 5) Written procedures for handling and storage of bulk AN should be communicated to employees and subcontractors and regularly reviewed.

More Information

1) ARIA No. 21329 https://www.aria.developpement-durable.gouv.fr/wp-content/files_mf/A21329_ips21329_008.pdf,
2) "Incidents That Define Process Safety", J. Atherton & F. Gil, Center for Chemical Process Safety (CCPS), ISBN 978-0-470-12204-4 (2008),
3) INDG230: "Storing and Handling Ammonium Nitrate", UK Health & Safety Executive (2004) https://www.hse.gov.uk/pubns/indg230.pdf.

Industry Sector	**Process Type**	**Incident Type**
Agrochemicals	Fertiliser	Explosion
Equipment Category	**Equipment Class**	**Equipment Type**
Not equipment-related	Not applicable	Not applicable

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