

SEPARATION DISTANCES FOR SOLID AMMONIUM NITRATE IN NSW

Submission from the Australasian Explosives Industry Safety Group Inc.

Introduction

The Australasian Explosives Industry Safety Group Inc. (AEISG) would like to thank the New South Wales (NSW) Government and SafeWork NSW for the opportunity to provide a submission for the 'Separation Distances for Solid Ammonium Nitrate in NSW Discussion Paper, October 2022'.

AEISG is an incorporated association representing all the significant manufacturers and suppliers of explosives and explosives precursors, essential to the mining and construction industries and so vital to the economic well-being of Australia and the States and Territories therein.

AEISG, and its member companies, have undertaken a thorough review of the NSW Discussion Paper, and our submission provides detailed feedback for the consideration of the NSW Government.

Our submission consists of the following sections:

1. Summary and Recommendations
2. AEISG Response to Consultation Questions
3. AEISG Detailed Feedback on the NSW AN Discussion Paper
4. Comparison of the proposed NSW Government's AN separation distances with established WA, QLD and AEISG distances
5. Copy of AEISG correspondence (22 April 2022) circulated to SafeWork NSW and other Australasian Regulators, which provided:
 - i. An invitation to provide feedback on the Final Draft of the AEISG AN Code;
 - ii. A summary of key aspects to the AEISG Code to assist Regulators with a better understanding of technical assumptions to assist in the provision of questions; and
 - iii. An offer to meet with each Regulatory agency to assist them with any key questions regarding the AEISG Code.

AEISG looks forward to its targeted consultation session with the NSW Government, following the Government's review of all submissions.

In the interim, if there are any queries or additional information that AEISG can assist with, please contact me.

Yours sincerely

A handwritten signature in dark ink, appearing to read 'R Bilman', is positioned above the printed name of the signatory.

Richard Bilman
Chief Executive Officer
AEISG

18 November 2022

1. Summary and Recommendations

1.1 Summary

Since its formation almost 20-years ago, AEISG has strived for and achieved success in continuously improving the level of safety and security throughout the life-cycle of explosives and associated precursors, as well as their use and handling in Australasia.

Improvement in the level of safety and security is also contingent on relevant regulatory bodies understanding and keeping abreast of industry issues, incidents, innovation and best practice. This culminates in improved legislative controls, effective administration of legislation and community safety.

The risks associated with the production, storage and transport of Ammonium Nitrate (AN) are well known and have been managed extremely well in NSW by industry through adherence to current legislation and, in addition, the implementation of best practice. AEISG acknowledges the role of SafeWork NSW, and its current focus on improved regulation of AN, and is committed to working with SafeWork NSW and the community, to ensure that industry is meeting the expectations of stakeholders.

AEISG, and its member companies, have conducted a thorough assessment of the NSW Government AN Discussion Paper and have used the opportunity of this submission paper to provide detailed feedback, recommendations and to share technical innovation / best-practice processes with Government.

AEISG is of the view that this Discussion Paper has been developed in haste, as the case for why this change is required, has not been made, nor has supporting evidence been supplied which identifies faults with the current system in operation. Instead, Government has relied on citing examples of past industrial accidents (predominantly from overseas) involving different product, conditions, standards, controls and practices to those in place in New South Wales. The inclusion of these events in the Discussion Paper is misleading to the public.

Similarly, the rationale for the proposed extreme AN separation distances is not supported within the Discussion Paper, with the quoting of specific items from referenced technical / legislative documents being inaccurate / taken out of context, e.g., the Safex International AN Good Practice Guide facilitates a risk-based approach, whereas the Government's discussion paper appears to 'cherry-pick' aspects to support a desired position. This desired position appears to be a prescriptive ultra-conservative consequence based approach, that if implemented, would result in NSW having the biggest AN separation distances in the world.

This desired position is incongruous with modern developments in the use of risk-based assessment (used in contemporary legislation) which considers both the probability of an event occurring and the potential consequences of that event, e.g., chemical / petroleum (oil and gas) industries in NSW utilise a risk-based process, as required under the NSW Major Hazard Facility regulations administered by SafeWork NSW. Further, this position is contrary to the NSW Government's own Land Use Safety Planning Paper (HIPAP 4), which sets a bench-mark for the use of risk criteria for the location of Major Hazard Facilities / Hazardous Industry in NSW, and is utilised by other Australian jurisdictions.

Confusingly, Government's intention is for the proposal to only apply to those parts of the AN supply chain that fall within the jurisdiction of SafeWork NSW – namely AN manufacturing sites, large intermediate transit stores and some small storage facilities. This excludes storage on mine sites and at ports, and road transport of AN. From a safety perspective, if the storage of AN is such a concern to Government and warrants the proposed ultra-conservative separation distances, why isn't this

safety principle applying to neighbours of mine / quarry sites and ports? For example, a 'vulnerable' facility such as a hospital or school neighbouring a quarry site / port which has an AN storage facility is not afforded similar 'protection'.

This directly undermines the stated objective of SafeWork NSW of creating consistency in storage standards, as this product would be stored at ports and mine sites, where SafeWork NSW does not intend to implement the proposed separation distances. This would have the effect of creating an unlevel playing field and introducing commercial inequities. Both of these outcomes are at odds with SafeWork's stated objectives.

This would have the effect of significantly reducing the amount of AN that can be stored on any given site (excluding mines and ports). It also has the effect of increasing the number of AN storage facilities in NSW to be able to accommodate smaller stockpiles, in order to maintain the total storage required by industry. A consequence of a greater number of AN sites is that there will be a much larger volume of heavy haulage vehicles on NSW roads.

Unfortunately, adherence to the proposed new separation distances would make existing storage and manufacturing locations unviable, and there is significant doubt within industry that suitable locations for re-establishing these functions could be found given land use challenges.

The Government's proposal represents a significant regulatory change through the implication of retrospective application of mandatory separation distances where, to date, no AN separation distances have been applied; this is contrary to a discussion held with senior SafeWork NSW officers at the May 2022 AEISG General Meeting, at which AEISG members were advised that the proposal would not impact existing licence holders.

AEISG has developed its submission from the perspective of assisting the NSW Government with the identification of pertinent facts and technical advances that may be of use to Government in further refining a position for the storage of AN in NSW. To this end, AEISG would be pleased to work with SafeWork NSW to demonstrate the effectiveness of the existing controls and refine any regulatory approach to ensure that it is practical, outcomes and risk-based.

1.2 Recommendations

During AEISG's review and response to Consultation Questions (Section 2 of this submission), key items of concern were identified and have been collated below for consideration and action by the NSW Government:

Recommendation 1 (re: Consultation Question No.1):

The NSW Government NOT adopt the proposed separation distances as detailed in the 'Separation Distances for Solid Ammonium Nitrate in NSW Discussion Paper, dated October 2022'.

Recommendation 2 (re: Consultation Question No. 1):

The NSW Government consider an appropriate risk-based approach, such as the AEISG Code of Practice – Storage and Handling of Solid Ammonium Nitrate, Edition 1, June 2022.

Recommendation 3 (re: Consultation Question No. 5):

That should any transitional period be required for potential changes in the future, the transitional period should be commensurate with the timeframe associated with sourcing new locations, seeking planning approvals, community and regulator consultation periods, construction and commissioning periods for a new storage facility.

Recommendation 4 (re: Consultation Question No. 6):

The NSW Government undertake a comprehensive review of its proposal including but not limited to the significant cost burden and associated implications upon the NSW AN supply chain, Minerals industry and ultimately the NSW community.

Recommendation 5 (re: Consultation Question No. 9):

SafeWork require to demonstrate the purported inadequacies of the current controls.

Recommendation 6 (re: Consultation Question No. 10):

SafeWork NSW should review the need for such reforms, consider the existing controls that are in place across the industry and work with the industry in a risk-based approach to address any gaps.

Recommendation 7 (re: Consultation Question No. 11):

NSW Government develop a comprehensive assessment of the impacts of the proposal, in consultation with industry, taking into consideration the flow on effects to the whole AN supply chain and the extensive work of AEISG that includes separation distances calculated using a scientific basis. The release of this assessment would be accompanied by a Regulatory Impact Assessment of costs / benefits of the various options and be subject to detailed industry consultation.

2. AEISG Response to Consultation Questions

1. Do you have concerns about the storage of ammonium nitrate in or around your local community? If yes, what are your concerns?

Member companies of the Australasian Explosives Industry Safety Group Inc. (AEISG) maintain, and continuously strive to improve, best-practice safety and security management of Ammonium Nitrate (AN). Our focus on best-practice safety and security is to reduce the potential of harm to the community in which we operate, including our workforce, neighbouring landholders, suppliers, customers, etc.

In continuously striving for best-practice, the AEISG Code of Practice – Storage and Handling of Solid Ammonium Nitrate, Edition 1 (the Code) was published in June 2022.

The Code was developed over a period of 6-years, which included significant research of International and National practices, and extensive consultation with SafeWork NSW and all other Australian regulatory jurisdictions.

The Code:

- Adopts precautions (against fire, contamination and shock) which are consistent with global AN codes / standards / guidelines;
- Adopts the SAFEX International AN Good Practice Guide "structure" of 3 initiation mechanisms, with different yields;
- Imposes mandatory separation distances for AN, which is categorised by the United Nations as a Class 5 dangerous good / oxidising solid;
- Is risk-based, i.e., distances required are numerically calculated to meet pre-defined risk targets, using conservative modelling assumptions;
- Risk targets used are as defined in the NSW Government's Hazardous Industry Planning Advisory Paper - HIPAP 4, and are exactly the same as used by the NSW Government for the siting of Major Hazard Facilities / Hazardous Industry;
- Risk targets must be met without any allowance for a reduction in risk due to evacuation processes being in place, i.e., a more stringent measure;
- All distances are individually modelled and cannot be calculated by simplistic formula;
- Demonstrates the critical flaws in the simplistic formula approach proposed by the NSW Government, which if implemented as proposed would provide insufficient separation distances for smaller quantities of AN storage to the NSW Community;
- AN explosions and consequences are modelled as AN and not TNT (it is inappropriate and inaccurate to model AN as some % of TNT), i.e., AEISG has modelled AN as AN utilising the comprehensive IMESA FR AN Module software. IMESA FR modelling is based upon field testing of AN and explosives; the predecessor of IMESA FR was developed for the USA Department of Defence;

- IMESA FR AN Module modelling considers several key factors that are overlooked by the NSW Government's AN Paper, including but not limited to the:
 - type of construction of an AN store
 - type of construction of a neighbouring building, including the type and percentage of glass in a building
 - orientation of buildings to further reduce risk
 - analysis of potential debris
- Takes transparency to new highs, with extensive explanation / substantiation of the basis of the requirements (i.e., why they are needed and how they are calculated) in both the body of the Code and technical appendices.

All AEISG member companies have ratified the AEISG Code of Practice – Storage and Handling of Solid Ammonium Nitrate, Edition 1, June 2022 - and therefore are compelled to comply with this AEISG Code

Recommendation 1:

The NSW Government NOT adopt the proposed safe separation distances as detailed in the 'Separation Distances for Solid Ammonium Nitrate in NSW Discussion Paper, dated October 2022'.

Recommendation 2:

The NSW Government consider an appropriate risk-based approach, such as the AEISG Code of Practice – Storage and Handling of Solid Ammonium Nitrate, Edition 1, June 2022.

The development of the AEISG Code has involved extensive research and ongoing consultation with SafeWork NSW, and all other Australian regulatory jurisdictions, and the Code is based on advanced field-based modelling, uses the most conservative assumptions, adheres stringently to the NSW HIPAP 4 requirements for protection of our community (without relying on evacuation), and has been embraced by the Australasian AN industry as world's best-practice.

2. Does the proposal incorporate appropriate measures to manage the risks associated with the storage of ammonium nitrate?

AEISG and its member companies are focused on, and supportive of improvement initiatives, ensuring the safety of the community. AEISG members utilise best-practice risk management to achieve this outcome.

However, the approach of the NSW Government is not focused on risk or risk-management.

It is based on the use of formulaic Quantity Distance tables that are purely focused on the consequence of an extremely unlikely worst-case event, i.e., the Government's approach is fashioned on a 'Beirut' type situation where there is no or very limited corporate governance and no government regulatory oversight – it is not within the bounds of reasonableness that SafeWork NSW, on behalf of the NSW Government, would allow the storage of potentially contaminated AN, for a period of years in an unsuitable warehouse where there is co-storage with fireworks, combustibles, etc.

The use of simplistic formulaic QD tables is flawed and this is evidenced by the comparisons undertaken of the proposed NSW Government distances against distances prescribed in QLD and WA, and against risk-based modelling conducted by AEISG. Graph 4 shows that for smaller quantities of AN, the NSW Government's approach prescribes safety distances less than what is required by the AEISG AN Code, whereas at larger quantities of AN, the consequence-based / Beirut approach of the NSW Government sterilises land by requiring a massive, and unnecessary buffer, mostly to a far greater extent than even WA or QLD regulations.

The approach by the NSW Government is akin to a land use 'buffer' around existing AN storage site, i.e., all consequence and no / very little risk management.

It is critical to remember that AN is classified by the United Nations (UN) as a Class 5 oxidising solid, and this classification has remained unchanged.

It is NOT an explosive, and the NSW Government's Paper does little to dispel this fact, in contrast it suggests that there are no obvious differences between the properties of AN, and Ammonium Nitrate Emulsions (ANEs), compared to Class 1 explosives.

Given that the NSW Government is focused on 'consequence', then in all likelihood there will be less than an optimal focus / oversight of the key control measures required under a holistic management system.

Question: What is the basis for the move to these extreme separation distances? Industry is aware that SafeWork NSW and the NSW Resource Regulator conducted inspections of AN storage post-Beirut, however there were no key issues of concern shared with industry.

3. How can ammonium nitrate storage facilities located near residential and commercial areas be made safer?

Please refer to the response to Question 1, above.

Both the NSW explosives and mining industries utilise mature risk-management systems, that mandate stringent compliance with key parameters and controls. This process is dovetailed with internal / external auditing to determine the level of compliance, identify opportunities for improvement and drive further improvements in safety.

The processes used by industry are consistently applied, regardless of the location of AN storage.

The NSW Government's HIPAP 4 paper has for decades been used both within NSW and other Australian jurisdictions, and is the benchmark for specifying Land Use Safety Planning criteria. The risk criteria specified in HIPAP 4 is consistent with the requirements of other countries / regions such as the United Kingdom, Europe and North America.

Adherence by the NSW Government to its publication, HIPAP 4, would ensure that those living / working in residential, commercial and industrial areas have a clear understanding of the pertinent risk criteria, how they apply to each of these groups within the community, and importantly confirm that these well-established risk criteria are not being exceeded.

4. What will be the impacts on industry and the community if the NSW Government's proposal is adopted?

Note: The mandate of AEISG is predominantly Safety and Security of explosives and precursors (e.g., AN) and NOT matters of a commercial nature.

Given the reliance of the NSW community on its successful minerals industry, and the significant economic benefit this industry provides to NSW, it is understood that an onerous restriction being placed upon a key ingredient (AN), used in the manufacture of explosives, will very likely have a disastrous impact on the minerals industry, and therefore upon NSW.

Adherence to the proposed separation distances would make most if not all existing storage and manufacturing locations unsuitable / economically unviable. Further, based upon the extreme separation distances proposed by the NSW Government, it appears highly unlikely that AN storage facilities forced to abandon existing storage sites will be able to find suitable new locations that allow viable operations.

AEISG is of the view, based on feedback from member companies, and other associations and companies intimately involved in the NSW AN supply chain, that the NSW Government proposal, if adopted, would jeopardise local manufacturing, significantly impact the NSW mining industry through loss of supplies and drive massively increased costs, and ultimately undermine the NSW economy.

5. What is an appropriate transition period to provide to existing sites which may have difficulty complying with prescriptive separation distances? What other strategies should be considered to enable existing sites to comply with prescriptive separation distances?

AEISG's understanding, during its regular communications with SafeWork NSW over a period of years, was that any additional regulatory requirements imposed upon AN storage, would not be retrospective, i.e., no impact upon any existing 'approved' sites, or licensable quantities.

We do not believe there would be an appropriate transition period for existing AN facilities in NSW (manufacturers, storage and transport) to enable them to meet the proposed separation distances.

Significant changes would be required to meet the prescriptive separation distances, and would not be possible for a large portion of existing NSW facilities, i.e., the available 'footprints' in the existing facility locations will always be deemed to impact existing communities, current infrastructure, public roads, train lines, etc. and make the ability to meet separation (and evacuation) requirements as proposed in the Discussion Paper insurmountable.

Recommendation 3:

It is recommended that should any transitional period be required for potential changes in the future, the transitional period should be commensurate with the timeframe associated with sourcing new locations, seeking planning approvals, community and regulator consultation periods, construction and commissioning periods for a new storage facility.

6. What barriers are there for existing facilities moving or relocating ammonium nitrate stores within sites, to comply with prescriptive separation distances?

The key barrier for existing sites / facilities to move / relocate AN storages within sites, to comply to proposed prescriptive separation distances, is the significant reduction of the amount of AN that can be stored on any given site, which would make most existing storage and manufacturing locations unviable. The reduction in existing store capacity due to the proposed distances may not be fully appreciated - it is not a few % , or even a quarter or a third - it is much bigger than that. For example, an existing site stores, say 4 x 500 tonne stacks of AN located 800 metres from a residential area that includes a small nursing home or a single 4-storey block of units, would have to reduce the individual stacks to 18.1 tonnes each to meet the Government's proposed separation distances. These smaller stacks would still require the same separation between stacks, so a store that currently accommodates 2,000 tonnes (in 4 stacks of 500 tonnes) would be reduced to accommodating approximately 288 tonnes (16 stacks of 18 tonnes) with 9 metres of stack separation), which would be totally inadequate to support existing supply chains and delivery volumes.

In the unlikely event that an existing site / facility had sufficient land to 'spread out' its AN storage (within its current licence limit), then additional barriers would include:

- Significant costs associated with multi-agency approvals, construction of a number of new AN stores and onsite infrastructure to service these new stores, including additional costs for provision of additional 'security' to these new stores.
- The costs of lessened productivity (i.e., due to duplication of functions at a site to cater for a larger number of stores), business interruption (e.g., construction activities would hamper operational activity).

Recommendation 4:

The NSW Government undertake a comprehensive review of its proposal including but not limited to the significant cost burden and associated implications upon the NSW AN supply chain, Minerals industry and ultimately the NSW community.

The case for why this change is required, has not been made, nor has supporting evidence been supplied which identifies faults with the current system in operation.

7. Are there any unintended consequences associated with the NSW Government's proposal, for industry and/or communities located within the vicinity of an ammonium nitrate storage facility?

There appear to be a number of unintended consequences associated with the NSW Government's proposal, that frankly both industry and community would have expected the Government to have researched, in order to put forward a well-considered argument, position and options in a discussion paper.

It is not currently clear why the NSW Government has chosen to take a 'tell us what we've missed' approach to an issue that it is pursuing with great haste.

Unintended consequences include but are not limited to:

- Significantly reducing the amount of AN that can be stored on any given site, and thereby increasing the number of AN storage facilities in NSW to be able to accommodate smaller

stockpiles, in order to maintain the total storage required by industry, to ultimately supply the NSW minerals industry.

- Adherence to the proposed new separation distances would make existing storage and manufacturing locations unviable.
- The proposal would result in the industry needing to replace existing domestic supply and storage locations with imported product.
- The proposal directly undermines the stated objective of SafeWork NSW of creating consistency in storage standards, i.e., AN is likely to be stored in significant quantities at ports, and mine sites, where SafeWork NSW does not intend to implement the proposed separation distances.
- A significant risk is imposed on the Community due to the considerable increase and frequency of AN road transport. This increase in road transport would be necessary to provide continuity of supply to end customers, from the Government imposing restrictions on existing AN sites and favouring a move to a greater number of 'smaller' AN storage sites.

Question: Is the NSW Minister for Emergency Services aware of, and comfortable with, this unintended consequence?

8. Do you think the prescriptive separation distances will achieve the desired safety outcome?

No.

The Government's proposal is narrow and ill-conceived, with no apparent consideration of unintended consequences, as highlighted in the above responses.

The desired safety outcome is achievable without the prescriptive and extreme separation distances proposed in the Discussion Paper.

There continues to be confusion within industry as to why the NSW Government has chosen to take aim at AN storage, without adequate forewarning and explanation when the history of AN storage in NSW, and other Australian states / territories, is fit-for-purpose and continues to involve a high degree of governance and oversight by both relevant companies and government jurisdictions.

A risk-based approach and a combination of controls will achieve the desired safety outcome in a practical and feasible way.

9. Are there other costs that the proposal should consider, such as socio-economic costs?

Retrospective legislation, if applied, may have a significant impact on the safety and security of AN in NSW, as well as a major impact upon the AN supply chain, and therefore the mining sector and economic well-being of NSW.

The Government's proposal, if implemented, is most likely to drive away investment in NSW and contribute to the decline of the local manufacturing industry.

Consideration should be given to how the costs associated with impacted infrastructure (if expansion or acquisition of new land is required to meet the proposed separation distances) will be funded. The expectation on industry and end users to cover costs of roads, power, water, etc., to gain access to remote locations will need to be considered if such areas, away from existing communities, are going to be viable options for existing and potential future industry stakeholders.

The case for why this change is required, has not been made, nor has supporting evidence been supplied which identifies faults with the current system in operation.

Recommendation 5:

SafeWork require to demonstrate the purported inadequacies of the current controls.

10. What measures can be taken to offset the potential economic impact of some within the industry?

Recommendation 6:

SafeWork NSW should review the need for such reforms, consider the existing controls that are in place across the industry and work with the industry in a risk-based approach to address any gaps.

11. Do you have any further comments regarding the NSW Government's proposal and the storage of ammonium nitrate in NSW?

There is a lack of clarity and understanding around the scope of the proposed changes. Whilst SafeWork NSW has only in the week prior to proposal submissions clarified, that the proposal at this time would not be applied to mine sites, it is difficult to understand how it would not be, as the NSW minerals industry operate under the same legislative instruments and are regulated and have licenses issued by NSW SafeWork.

There is insufficient discussion of the technical issues that drive the development of the proposed separation distances put forward in the Discussion Paper. The TNT equivalent approach is too simplistic and the technical information that supports the proposed distances needs to be reviewed based on more appropriate options that are better reflective of the risk associated with solid AN. The current proposal has adopted the formula from AS 2187 for the separation distance from Class 1 explosives, whereas AN is classified as a Class 5 oxidising solid. SafeWork NSW have not taken into consideration the properties of AN, nor has it conducted modelling of a potential AN storage incident.

The proposed changes in the Discussion Paper includes transit stores for loading and change of drivers, parking area, etc., which will therefore also be required to meet the calculation for minimum distance (i.e., 518m for a loaded B Double). The practicality of parking transport trucks 518m from other trucks or the community is not achievable. The proposed transport and separation distances in the Discussion Paper are contradictory to the existing Australian Dangerous Goods Code for Transport (ADG Code). It is unclear if the intent would be for the ADG Code to also be updated as an outcome of the proposed changes.

The ripple effect on transit storage, deliveries and transport do not appear to be well understood by SafeWork NSW. A potential lack of awareness of the magnitude of this proposal and the supply chain impacts, disruption to the minerals industry, and the financial impact on the state of NSW is significant. A proposed change such as this should have a cost / benefit assessment conducted to determine the potential outcomes across the state of NSW.

The NSW Government has chosen to rely on citing examples of past industrial incidents (predominantly from overseas) involving different product, conditions, standards, controls, practices and the level of government oversight to those in place in NSW. The inclusion of these events in the Discussion Paper is misleading to the public, who may not be well informed on the current NSW legislative requirements. The use of these examples only threatens to increase community anxiety. Government has a responsibility to maintain public confidence and the use



of misleading examples which suggest equivalence with circumstances in NSW is inaccurate and damaging.

Recommendation 7:

NSW Government develop a comprehensive assessment of the impacts of the proposal, in consultation with industry, taking into consideration the flow on effects to the whole AN supply chain and the extensive work of AEISG that includes separation distances calculated using a scientific basis. The release of this assessment would be accompanied by a Regulatory Impact Assessment of costs / benefits of the various options and be subject to detailed industry consultation.

3. **AEISG Detailed Feedback on the NSW AN Discussion Paper**

Section 1.1 Purpose of the Discussion Paper

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General: There are several references on this page to 'risk' and 'risk-management', however in the context of the NSW Government Paper (NSW Paper), these references are not accurate, given that the NSW Paper is solely focused on mandating consequence distances.

Paragraph 1: AEISG acknowledges the aim of the NSW Government is to strive to meet global best practice to manage the 'associated risks' of storage of Ammonium Nitrate (AN). Unfortunately, the NSW Paper does not provide any references on how the NSW Government have come to a consequence only approach, nor current global best practice.

The approach suggested by the NSW Government is not consistent with modern developments in the use of risk-based assessment (which consider both the likelihood of an event occurring and also the consequence of that event). Further, the approach by the NSW Government is not consistent with the NSW Government's Land Use Safety Planning approach, contained within 'Hazardous Industry Planning Advisory Paper No 4, Risk Criteria for Land Use Safety Planning'.

It is respectfully suggested that the NSW Government, as a minimum, review the AEISG Code of Practice – Storage and Handling of Solid Ammonium Nitrate, Edition 1, June 2022, as the AEISG Code provides references to a broad range of national and international AN standards / codes / guides.

AEISG would be pleased to assist the NSW Government in locating / obtaining reference documents.

Currently, the NSW Paper suggests implementing a significant deviation from world's best-practice but does not provide any scientific justification or validation to its proposal AN separation distances.

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Paragraph 2: AEISG agrees that separation distances do introduce an additional level of protection to ensure that communities are protected. For this reason, the use of separation distances have been used successfully for decades in Australia as part of a balanced risk-management approach for the storage of both MHF and non-MHF quantities of AN storage.

The NSW Paper provides no scientific rationale or justification for its proposed separation distances, nor what constitutes 'adequately separated'. It appears that the NSW Government is focused solely on consequence distances at the expense of all other management controls and systems that form part of a modern approach to risk-management. In addition, these consequence distances are calculated on a technically inaccurate basis, both in the conversion from AN to supposedly "equivalent" TNT, and in the assumed risk arising from particular levels of estimated explosion overpressure. And beyond that, these ultra conservative distances are intended to be applied not only to people who might potentially be at risk, but also to many classes of other structures or facilities which are not routinely occupied.

The NSW Paper suggests that the current NSW explosives legislation sets mandatory separation distances for both explosives and the explosive precursor Ammonium Nitrate Emulsion (ANE), and that AN is the only substance regulated by the explosives legislation for which there are no prescribed separation distance requirements. Advice provided to AEISG is that:

- distances are not detailed in either the Act or Regulations but for class 1 explosives (AS 2187 is called up by the Regulations); and the AEISG ANE Code is called up via licence conditions for ANE.

The NSW Paper refers to AS 4326 – The storage and handling of oxidising agents, and states that the Standard identifies the need for separation distances for ammonium nitrate but defers to the regulator to determine those distances. AEISG's understanding is that in the context of AS 4326:

- AS 4326 does not identify a need - it simply requires that:
 - IF the state or territory regulators have specified distances, they must be complied with, i.e., "The separation distances to protected places and boundaries given in the relevant State or Territory regulations shall apply."; and
 - In respect of vulnerable facilities and critical infrastructure only, "The regulatory authority shall be consulted with regard to any separation distances relating to stores for ammonium nitrate." which, as worded, would accommodate having no prescribed distances, i.e., "any" distances, not "the" distances.

Section 1.2 Benefits of the proposal

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Paragraph 1: The introduction to this section focused on the 'benefits' of the proposal, however, does not mention the 'negatives'. Has the NSW Government considered these negatives, e.g. increased safety and security risks from greater numbers of storages, more transport of AN, increased costs to the community?

The introduction also refers to raising safety standards in NSW to a "best-practice standard already used in other Australian jurisdictions". However, the proposed NSW distances are the most conservative (by a significant margin in many cases) and there appear to be significant omissions in the NSW Government's approach to those of other jurisdictions, e.g., permitting the use of Quantitative Risk Assessment in lieu of prescribed conservative separation distances. Is the intention of the NSW Government to be consistent and take a balanced approach to that employed by other jurisdictions?

In addition, it is entirely debatable whether the WA and QLD jurisdictions are 'best-practice'. Of global 'developed economies', which jurisdictions do and do not use this suggested practice, and why?

Sentence 2: The "standard of separation distances" is not the same for explosives and ANE, since ANE has a "credible evacuation" mechanism whereas AS 2187 does not.

Based on the NSW Paper and the SafeWork NSW (SWNSW) webinar held on 10 November 2022, the perception of industry is very clearly that SWNSW, on behalf of the NSW Government, has simply chosen to include in its approach to AN storage, the most conservative measures, without providing any demonstrable scientific justification.

Sentence 3: This sentence refers to consistency of regulations to the NSW explosives legislation, yet it fails to acknowledge that AN is NOT a Class 1 explosive. There is no scientific basis for the treatment of substances as being the same.

Paragraph 2: This is written in an alarmist fashion and suggests that an explosion will occur 'tomorrow'. What is the purpose of using emotive language? Could the NSW Government please provide AEISG with its analysis of all available data to support the statements made in this paragraph.

Paragraph 3: The intention of this paragraph is unclear and currently suggests that the application of a conservative Quantity-Distance (QD) approach means that no emergency management / response / evacuation is necessary.

Paragraph 4: The message in this paragraph, which was reiterated in the SWNSW webinar (10 November 2022) claims that 'mandating a one-size-fits all approach' to AN, ANE and Class 1 explosives will in some way "lifts barriers that inhibit investment in NSW". What is the basis for this claim – it needs to be substantiated?

If there had been detailed data gathering prior to the NSW Government's Paper, it would have been clear to the NSW Government that its proposal for the biggest separation distances in the world will dissuade new entry into the NSW market and may potentially result in the exit of existing business.

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Paragraph 1

Sentence 2: This does not make sense as the NSW Government's proposal mandates a new set of separation distances.

Paragraph 2: This is inaccurate - based on the consistent messaging provided by SWNSW at its webinar (10 November 2022), there is no intention by the NSW Government to be consistent in the application of, and drive, for continuous improvement of complex assessment and planning in relation to hazardous activities. It is clear that an aim of the NSW Government's Paper is to justify why AN storage should be differentiated from NSW hazardous industry / Major Hazard Facilities (MHFs).

Section 1.3 Acronyms and abbreviations used in the Discussion Paper

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AEISG is the acronym for the 'Austral~~as~~ian Explosives Industry Safety Group Inc.'

ANE means 'Ammonium Nitrate Emulsion, Suspension or Gel'

UN 2067 the Proper Shipping Name is 'AMMONIUM NITRATE BASED FERTILISER'

Vulnerable Facility – it is noted that this is a slightly reworded version of the AS 2187 definition, i.e., drops the "includes but not restricted to" wording, and the reference to "above 4 storeys", so presumably now include 2, 3 and 4 storey buildings?

Section 2.3 Recent incidents

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Paragraph 1: This is inaccurate, and alarmist, as none of which are relevant to AN storages in Australasia.

Paragraph 4: This does not appear accurate, as it is understood that what NCAT actually said is:

"Crawfords make the point that SAFEX, the WA Code and Qld IB53 each take somewhat different approaches to a range of matters, including separation distances. As a result, Crawfords states that it would be unjust and unfair to apply these codes. As I understand it, NSW is moving towards having such a code in this state and that is clearly the preferable outcome in terms of transparency and consistency across the industry."

Therefore, it should be noted that the presence of a state code is the preferable outcome, not "standardised and published separation requirements".

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Paragraph 1: This is alarmist and does not provide context, e.g., the NSW Government is well aware that the Beirut explosion resulted from the incompetent storage of AN with fireworks, combustible liquids, etc., by, amongst others, Government agencies.

The use of ultra-conservative separation distances is appropriate for jurisdictions that do not have an appropriate level of corporate and government oversight. Industry is of the view that its operation in NSW, and the NSW Government, have a high-level of oversight.

Section 3.1 Legislation – Explosives Act and Explosives Regulation

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Paragraph 2:

Sentence 1: The context of this sentence is incorrect, as it does not refer to the legitimate use of explosives to benefit the community. Without a legitimate use for explosives and explosives precursors, why would the NSW community have need for these materials?

Last paragraph:

Sentence 1: Is SWNSW aware that this 'key technical code' also allows co-storage of nitrites and chlorates with AN, and requires stack separations of only 3 metres?

This is an example of the NSW Government picking, by exception, aspects of certain reference documents to suit its purpose, but not accurately reflecting context.

Section 3.3 Other jurisdictions

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Last 2 paragraphs: This is not correct. The SAFEX Good Practice Guide (Safex GPG):

- DOES NOT prescribe quantity-based distances from AN to protected works as implied in the NSW Government's Paper;
- It advises a set of formulae that MAY be used in certain circumstances (i.e., when AN is stored with explosives) but otherwise recommends a quantified risk assessment.

Significantly, WA and QLD do not prescribe THE SAME distances nor do they apply to THE SAME "protected works" and in both cases, their codes allow for different distances if supported by a risk assessment. It is disingenuous to suggest that QDs are used in all cases.

Why have the NSW Government limited its Paper to only one (1) global reference?

Section 4.1. Prescriptive separation distances

Page 12 of 23

2nd dot point: This is incorrect as AS 4326 allows other chemicals within the AN storage area.

Paragraph 2:

Sentence 3: This is incorrect.

AS 2187.1 and the AEISG ANE Code are considered to reduce consequences to an acceptable level, because the probability of an incident is conservatively placed at '1'. In addition, the distances specified by AS 2187 are not prescriptive as written in the standard itself (but may be via other instruments) - those distances are specifically stated as being guidance distances which should be considered in the context of many other factors at particular sites.

Last paragraph: Retrospective application of prescribed ultra-conservative separation distances is a very severe and unusual approach and will most definitely result in extensive costs for industry.

Section 4.2 Application of separation distances

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Paragraph 3: How realistic is the NSW Government's strong recommendation that separation distances remain entirely within the boundary of the facility? Industry is of the clear view that this is NOT likely at the massive distances contemplated.

Section 4.2.1 Method for calculating separation distances

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Paragraph 2: The NSW Government claims that a TNT equivalence of 32% 'is consistent with other relevant sources'. Given that the Government's Paper refers to the WA AN code and the SAFEX GPG, this claim is inaccurate as WA uses 25% and SAFEX has a range of values (or at least supplements the 32% "chemical equivalence" with a separate consideration of "yield" - ending with a range of "overall TNT equivalence" values. So, the Government's proposal is INCONSISTENT with the sources it has referenced.

Section 4.4.2 Separation from other ammonium nitrate stores

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Paragraph 2: In other codes it is not mandatory to separate stacks - it is mandatory to allow for aggregation if the separation is NOT achieved. Could the NSW Government please clarify if its intention is to be consistent with other codes?

Section 4.4.3 Separation from explosives and ammonium nitrate emulsion (ANE) stores

Page 16 of 23

Sentence 1: The proposal is for AN to be separated from explosives and ANE stores by the distances outlined in Table 2, however if this were to be implemented then these distances would rule out most existing depots, as AN tends to be in the vicinity of ANE, to facilitate loading MPU's.

Section 4.5 Off-site separation distances from ammonium nitrate

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Table 3, notes (b) to (d), inclusive: Table 3 is based on AS 2187 formulae, which are applicable to only TNT. What is the scientific justification for this approach? In an explosion, AN does not act like TNT – please refer to Section 4, Chart 1 and Table 1, of this AEISG submission.

Section 4.6 Evacuation time requirements

Page 17 of 23

2nd dot point: This is inconsistent with Section 1.2, where it was suggested that the application of QD separation distances would eliminate the hazard of emergency response. i.e:

'A facility with appropriate separation from the community has a built-in exclusion zone that precludes any evacuation or active emergency management.'

Section 4.7. Impacts on industry

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1st and 3rd dot points: There will be few, if any, AEISG member company legacy (existing) sites that currently comply with the suggested NSW Government position.

Most AEISG member company legacy sites could NOT comply with the proposal.

6th dot point: 'Upgrading' existing facilities is not likely to be feasible to the operation of existing AN storage sites, as the only option appears to be a huge reduction in the quantity in each AN stack, so unless a site is particularly large, the operation is likely to be ineffective.

9th dot point: This proposed solution, potentially increases safety / security risks by having increased numbers of smaller AN storages.

10th dot point: This proposed solution, potentially increases safety risks from more vehicles on road covering larger distances.

Paragraph 6: It is clear to AEISG member companies with existing AN storage sites that compliance with proposed NSW Government separation distances is unlikely to be possible.

It is the strong recommendation of AEISG that the requirements of the NSW Government AN Paper NOT be retrospective.

Section 4.8 Interaction with DPE safety planning legislation

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Sentence 2: The NSW Government's proposal is in conflict with the risk levels considered acceptable for hazardous industries in NSW, i.e., as specified in HIPAP 4. Rather than '...improving land use...' the NSW Government's proposal would unnecessarily sterilise land use around AN storages.

4. Comparison of the proposed NSW Government's AN separation distances with established WA, QLD and AEISG distances

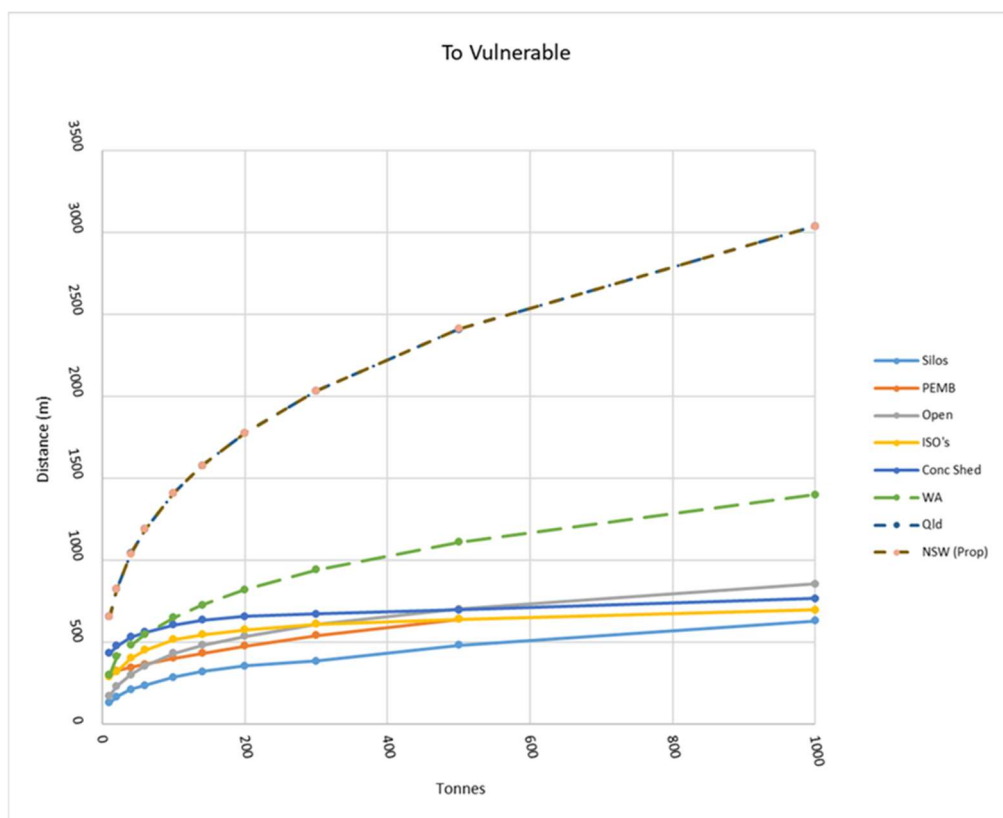
The graphs below show how the required distances from an AN store increase according to the amount stored, for four (4) sets of specified distances:

1. Queensland (Current edition of EIB 53);
2. Western Australia (Code of Practice, Safe Storage of solid ammonium nitrate, Fourth edition (reissued));
3. AEISG Code of Practice – Storage and Handling of Solid Ammonium Nitrate, June 2022, Edition1; and
4. NSW - Proposed separation distances.

The charts compare the distances required under the four (4) different sets of "rules" but it should be noted that there is not a complete overlap in the definitions of which sites need which distances, since WA distances apply to "off-site occupied buildings", AEISG apply to "land uses" whereas Qld and the NSW proposal refer to a structure of protected places. In addition, there is not a complete overlap of the exact definitions of what is included in each type of land use or protected place. And finally, the AEISG distances are based on meeting a defined risk target (NSW HIPSP 4) whereas WA, QLD and NSW are all variations of a QD approach.

(Note: The AEISG Code distances for Pre-engineered Metal Building (PEMB) only go up to 500T, since the building modelled cannot physically store more than 500 t).

Graph 1a - 'Vulnerable' locations, e.g., a hospital



Graph 1a - Distances to a vulnerable land use.

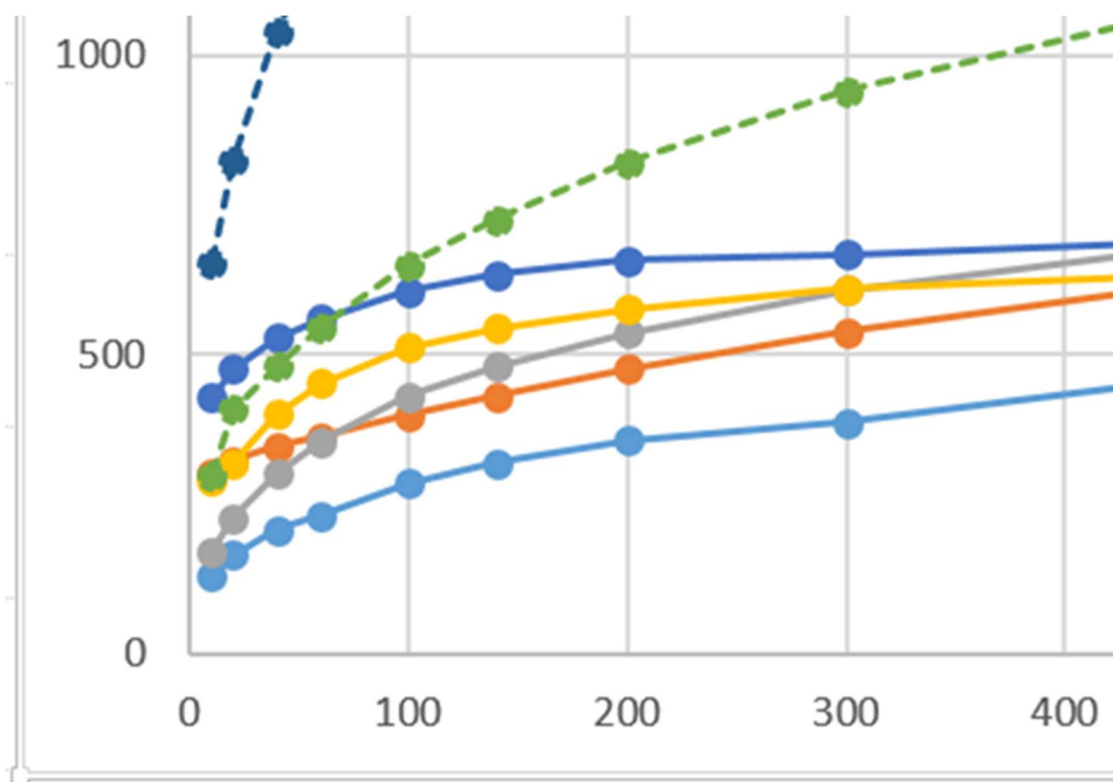
For example, for a hospital, the distances required from an AN store with 500 tonne stacks would be:

- AEISG: approx. 700 metres (for an 'Open' or 'Concrete' AN store)
- WA: approx. 1,130 metres
- QLD and NSW: approx. 2.4 Kilometres

Note: that under the NSW proposal the same distance (i.e., 2.4 Kilometres) would apply (in NSW) to:

- any "multi story" building, e.g., stories;
- ANY size of:
 - healthcare facility (e.g., dentist's waiting room)
 - school
 - childcare centre

Graph 1b – Magnified view of 'Vulnerable' locations



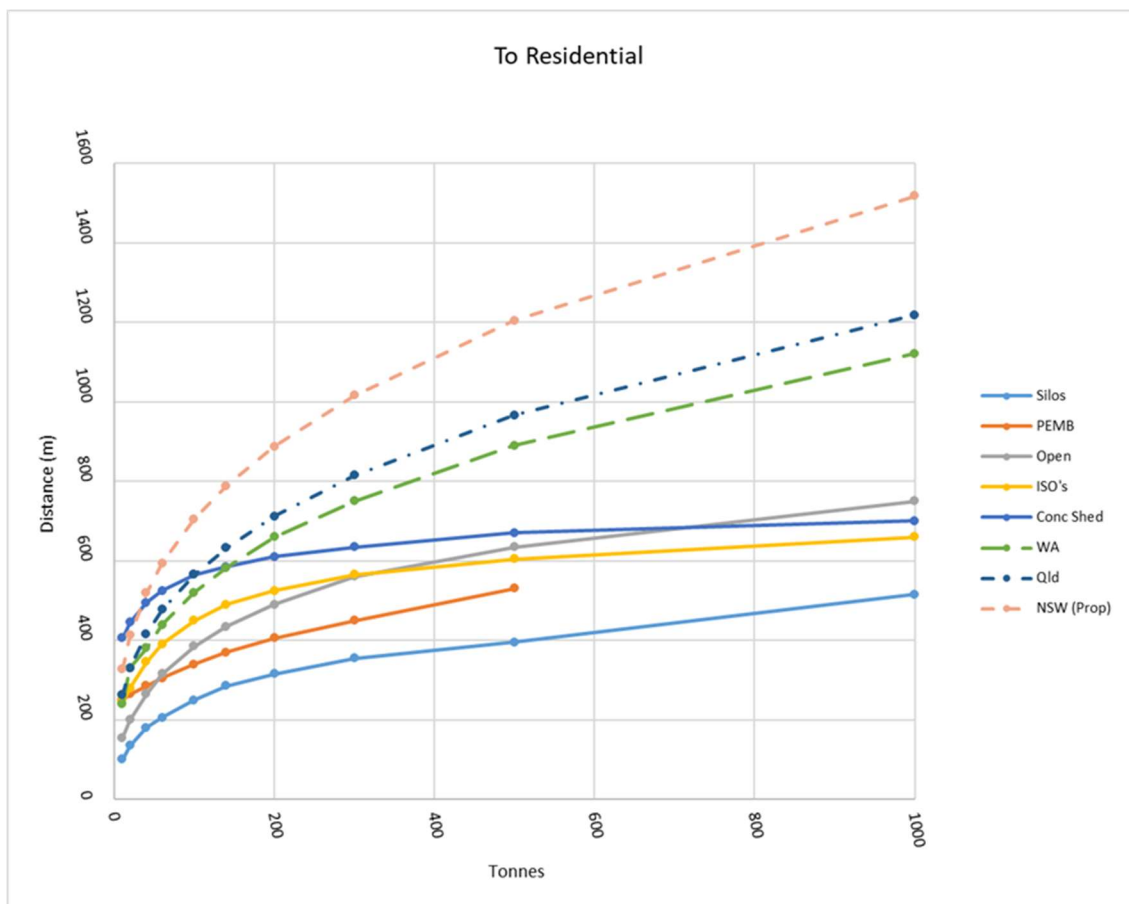
Graph 1b: Magnified graph

Shows that the AEISG (risk based) distance modelled for a 'concrete' store exceeds the WA criteria up until about 60 t of AN;

It could be concluded from this graph that:

- the WA requirements up to 60t may be insufficiently conservative; whereas
- QLD and NSW requirements are grossly / ultra-conservative.

Graph 2 - 'Residential' locations, e.g., low density housing

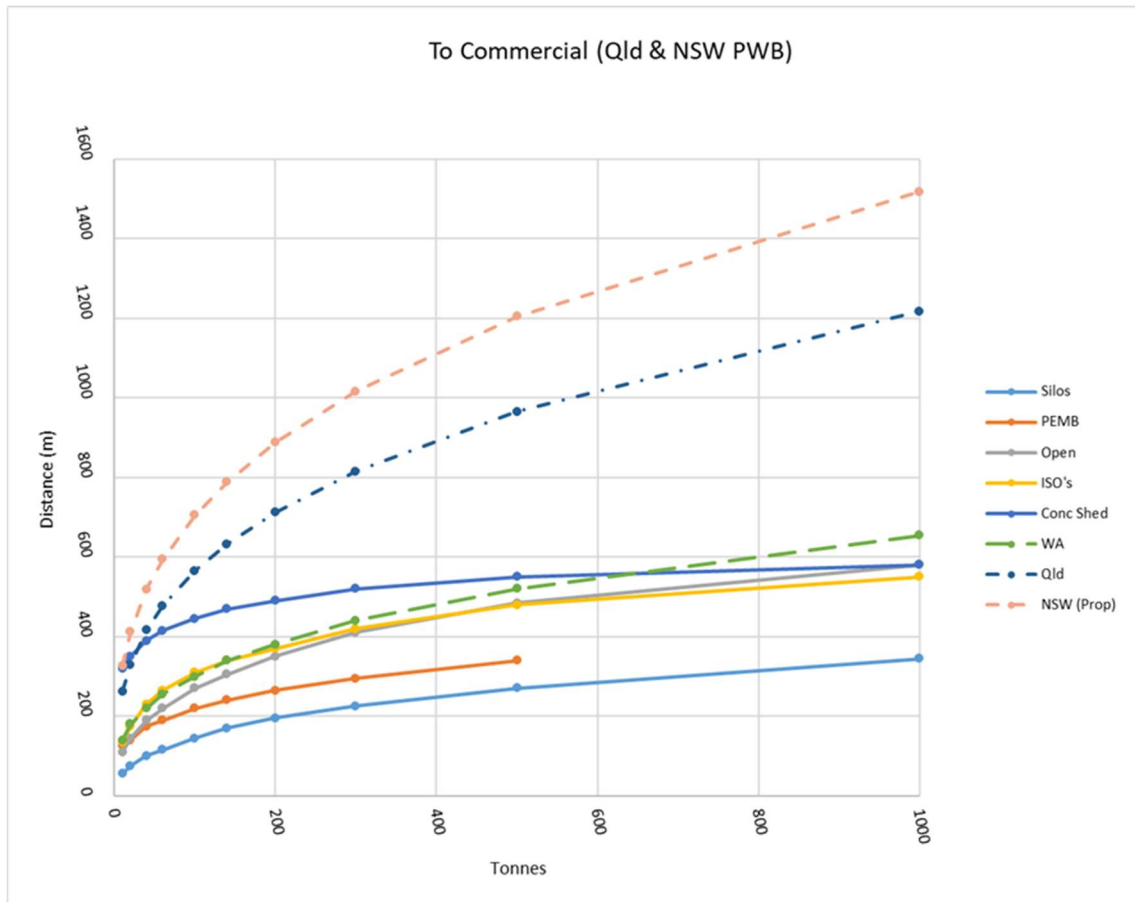


Graph 2 - Distances to a 'Residential' land use

In AEISG's view:

- for smaller tonnages of AN, all jurisdictions' (WA, QLD and NSW) distances may be insufficient for some types of AN store construction; but
- for larger tonnages of AN, all jurisdictions' distances once again become ultra-conservative.

Graph 3 - 'Commercial' land use, e.g., an office or shop
 (Note that Qld and NSW do not specify "commercial" distances so for these the graph shows PWB.)



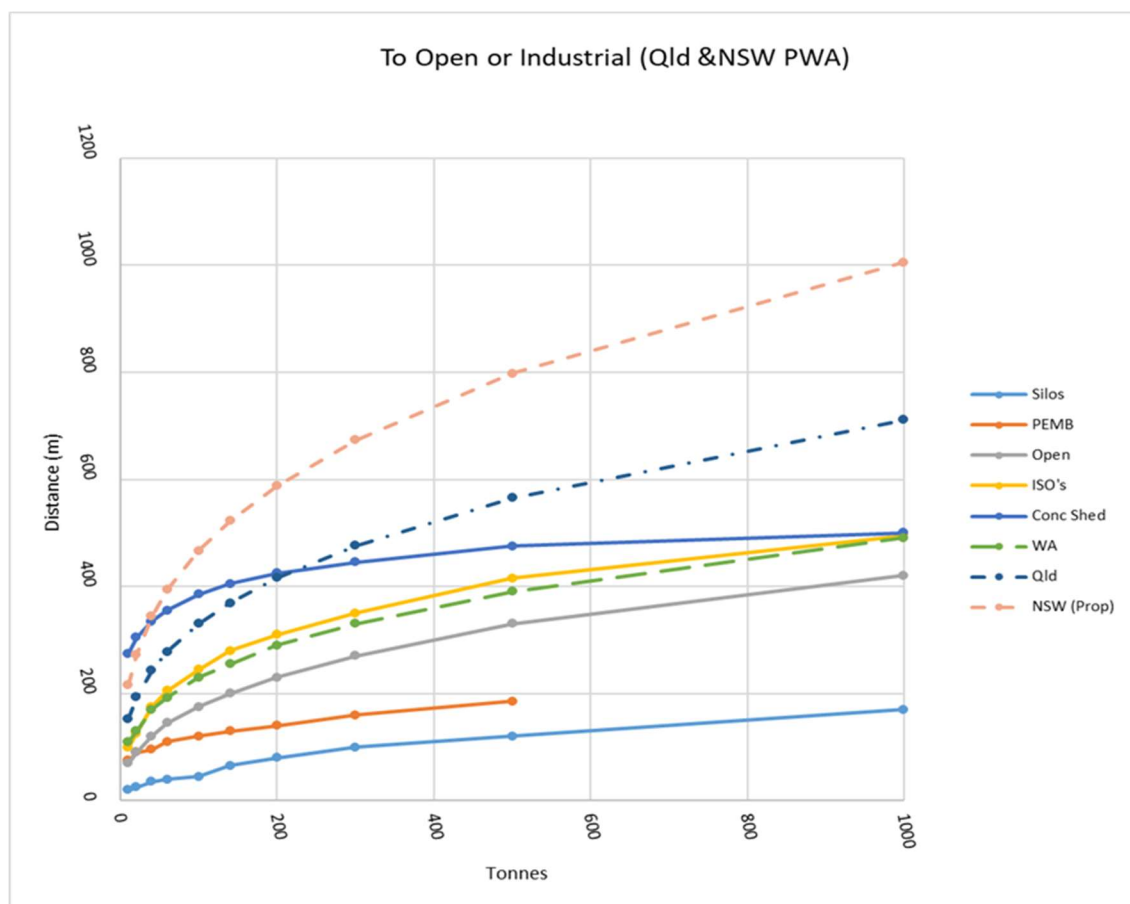
Graph 3 - 'Commercial' land use

In AEISG's view:

- There is, again, no rational or scientific-based justification for NSW distances;
- WA distances are generally similar to the middle range of the AEISG distances; but
- Qld and NSW are grossly over conservative, especially at larger tonnages.

Graph 4 – Land use locations for ‘Open’ (e.g., a sports ground) or ‘Industrial’ (e.g., a factory)

(Note that AEISG specifies the same distances for ‘Open’ and ‘Industrial’, WA has no ‘Open’ so WA graph shows distances for ‘Industrial’, and Qld and NSW have no ‘Industrial’ so distances are for PWA.)



Graph 4 - ‘Open’ and ‘Industrial’ land uses

In AEISG’s view:

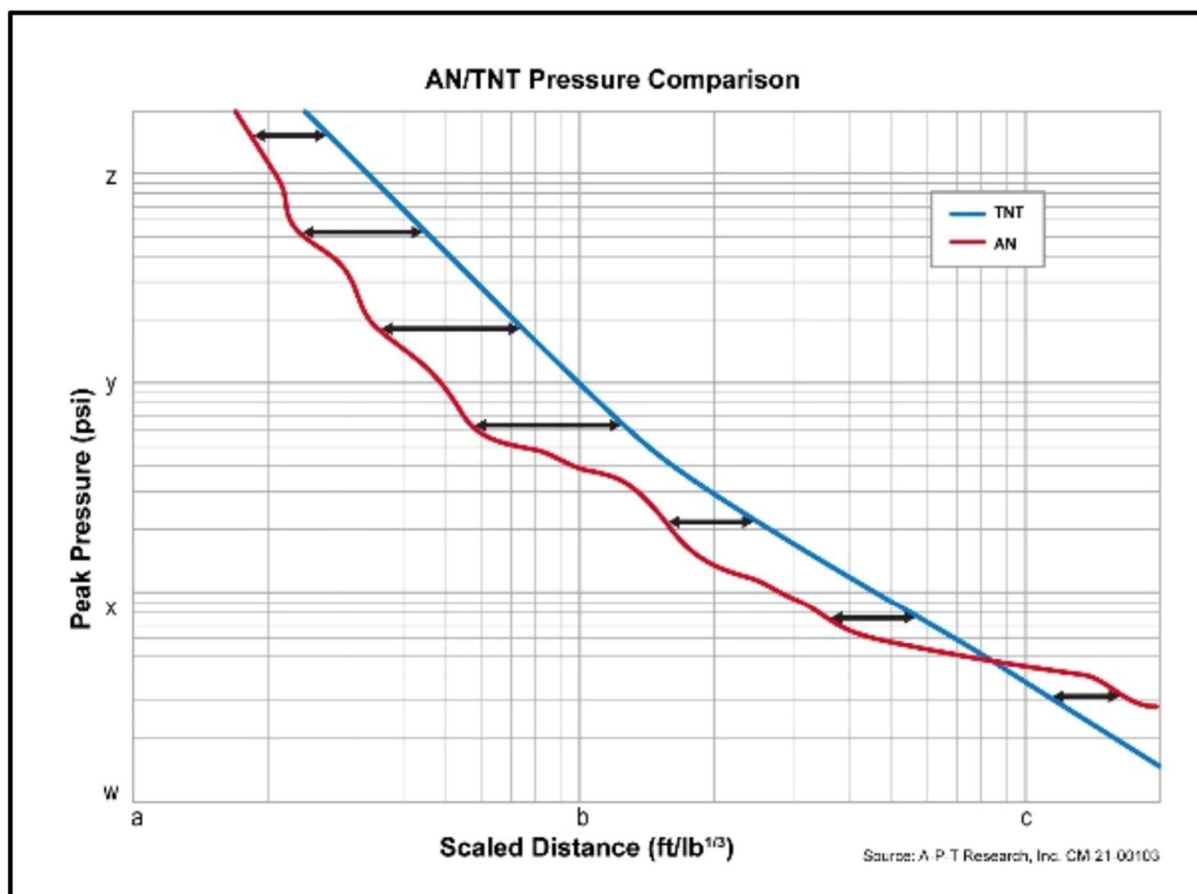
- for smaller tonnages of AN, all jurisdictions’ (WA, QLD and NSW) distances may be insufficient for some types of AN store construction; and
- Qld and NSW are grossly over conservative, at larger tonnages.

Why the difference?:

- A risk-based approach cannot be reproduced by a simplistic QD formula; whereas
- Each of the jurisdictions use a variation of a one-size-fits-all formula, which may be appropriate for explosives storage but not for AN

Chart 1 illustrates the difference in peak pressure obtained for an AN explosion compared to a TNT explosion of nominally similar size. The chart units are imperial rather than metric and discussion of the technical underpinnings of scaled distance is beyond the scope of this document (AEISG submission), but the key point is the significant difference in the shape of the curves - it is impossible to create any significant alignment of the curves, because the waveform arising from an explosion of AN is fundamentally different to that arising from TNT.

Chart 1. AN / TNT Peak Pressure Comparison



In addition to the waveform difference explained above, an explosion involving AN is unique in that there is the potential for large amounts of unreacted material (AN prill) that could be entrained (carried) in the blast wave. The opposite applies to a TNT explosion, where it is expected that the entire mass of aggregated TNT will explode. This means in the very conservative approach proposed by NSW Government for an equivalent mass of TNT (i.e., prescribing AN as 32% TNT equivalence) there will be less energy from the explosion source from an AN explosion that will decrease the peak and impulse pressure for the airblast or overpressure compared to the equivalent mass of TNT.

Comparison of AEISG AN separation distances to proposed NSW Government Separation Distances

The separation distances and risk criteria used in the AEISG AN Code were applied to the proposed separation distances specified in the NSW Government Discussion Paper, to demonstrate the significant difference in AN (AEISG Code models AN as AN) to TNT (NSW proposed distances are based on AN being converted to a 'TNT Equivalence') peak pressure waveforms.

Table 1 shows the results for AN stored in a metal building (a common form of storage in Australia) and provides the distances for vulnerable (NSW HIPAP 4 criteria of 5.0E-7 fatalities / year) and residential (NSW HIPAP 4 criteria of 1.0E-6 fatalities / year).

Note: The NSW Government's HIPAP 4 criteria is considered to be the bench-mark for quantitative risk assessment associated with Land Use Safety Planning (LUSP) in Australia.

The separation distances for each AN mass in Table 1 for the AEISG Code were calculated using IMESA^{FR}¹ and the assumptions and input data for these results is published in the AEISG AN Code. The same input data and assumptions used by AEISG were then taken, along with the proposed separation distances from the NSW Government Discussion Paper and calculated in IMESA^{FR} to determine a risk of fatality / year.

In all cases, for the same mass of AN, the proposed separation distances from the NSW Government Discussion Paper produce a level of risk of fatalities per year, orders of magnitude smaller than the risk criteria specified in the NSW Government's LUSP criteria, i.e., HIPAP 4.

These results demonstrate that the proposed separation distances published in the NSW Government Discussion Paper (TNT waveform) are drastically more conservative than those in the AEISG AN Code (AN waveform) as a result of the TNT waveform being inappropriately applied to AN.

Table 1 - Risk criteria for AN – comparison of AEISG Code with NSW Government Discussion Paper

(Note: this comparison is for AN stored within a 'Pre-engineered Metal Building'³ (PEMB))

	AEISG AN Code Vulnerable	NSW QD	Risk Level NSW QD (worst case ES)	ES ² Type	AEISG AN Code Residential	NSW QD	Risk Level NSW QD (worst case ES)	ES ² Type
HIPAP 4 Risk Criterion	5.0E-7	32% TNT	-	-	1.0E-6	32% TNT	-	-
Quantity of AN stored (tonnes)	Minimum Distance Required (metres)							
10	300	654	1.94E-10	Open	250	327	3.59E-7	Open
50*	355	1119	2.87E-11	Small Masonry; Small Wood Frame	295	559	3.33E-8	Small Masonry; Small Wood Frame
100	400	1410	2.72E-11	Small Masonry; Small Wood Frame	340	705	3.50E-9	Small Masonry; Small Wood Frame
200	475	1776	5.02E-11	Small Masonry; Small Wood Frame	405	888	5.10E-9	Small Masonry; Small Wood Frame
500	640	2410	1.14E-10	Small Masonry; Small Wood Frame	530	1205	7.09E-9	Small Masonry; Small Wood Frame

Note 1: IMESA^{FR} is a specialised risk-assessment tool that has the capability to model AN as AN.

Note 2: 'ES' denotes a type of 'Exposed Site' modelled in the AEISG AN Code.

Note 3: A Pre-engineered Metal Building is one (1) of five (5) types of AN store modelled in the AEISG AN Code.

The AEISG Code of Practice – Storage and Handling of Solid Ammonium Nitrate, June 2022, Edition 1 is freely available from the AEISG website www.aeiscg.org.au



5. AEISG Code of Practice - Storage and Handling of Solid Ammonium Nitrate

(Note: Paper circulated to Australasian Regulators 22 April 2022)

To Relevant Regulatory Bodies in all Australian States / Territories and New Zealand (via email)

Re: AEISG Code of Practice - Storage and Handling of Solid Ammonium Nitrate

The Australasian Explosives Industry Safety Group Incorporated (AEISG) is pleased to advise that it has now completed a Final Draft of the AEISG Code of Practice (CoP) – Storage and Handling of Solid Ammonium Nitrate.

This CoP has been in preparation since 2016 and will provide the Australasian, and global, industry with a best practice risk-based approach for the safe storage and handling of solid ammonium nitrate.

During the development of the CoP, AEISG had ongoing interactions with relevant regulatory bodies to provide updates on the approach to the CoP and its development status, via regular meetings, presentations at AFER and CAP, and consultation via a detailed interim CoP position paper in late 2020. Additionally, some regulatory bodies accepted an invitation to participate in an Ammonium Nitrate (AN) Technical Panel, which had a primary objective to develop a scientifically based and verifiable risk-based approach to the storage of AN.

Please find attached (Attachment 1) a copy of the Final Draft of the AEISG Code of Practice – Storage and Handling of Solid Ammonium Nitrate. AEISG welcomes comments on this CoP, in particular material comments, by no later than Friday 13 May 2022. AEISG will consider material comments as part of its process to finalise and publish this CoP in May / June 2022.

To assist your organisation with any key questions regarding this CoP:

- A summary of key aspects to this CoP is attached (Attachment 2); and
- AEISG is available to meet virtually with your organisation prior to the closing date for comments.

If any clarification is needed or to pre-arrange a virtual meeting, please in the first instance contact the AEISG Liaison Officer, Ms. Davina Blake (davina.blake@aeisg.org.au). For a virtual meeting, please provide the following details:

- Names and email addresses of the officers representing your organisation; and
- Nominate at least two virtual meeting dates, including commencement times and duration.

AEISG very much appreciates the contributions of relevant Australasian regulatory bodies during the development of this CoP, and in particular the extracts that are included from the WA Code, and looks forward to comments provided.

Yours sincerely

Richard Bilman
Chief Executive Officer
AEISG

Attach. 1: AEISG Code of Practice – Storage and Handling of Solid Ammonium Nitrate, Final Draft, April 2022

Attach. 2: Summary Paper (AEISG Code of Practice – Storage and Handling of Solid Ammonium Nitrate, Final Draft, April 2022)

SUMMARY PAPER

AEISG CODE OF PRACTICE – STORAGE AND HANDLING OF SOLID AMMONIUM NITRATE

FINAL DRAFT, APRIL 2022

1 Purpose

The purpose of this summary paper is to assist regulatory bodies and other stakeholders in their review of the Australasian Explosives Industry Safety Group Incorporated (AEISG) Code of Practice – Storage and Handling of Solid Ammonium Nitrate ('Code').

Note, it is not the intention of this summary paper to reproduce the detail contained in the preliminary AEISG proposal paper ('preliminary paper') dated August 2020, shared with regulators for comment. The objective of that (preliminary) paper was to provide an opportunity for AEISG to outline its intended approach to the development of the proposed Code.

This summary paper focuses on the subsequently developed Code, to provide a high-level overview of the fundamentals forming the basis of the AEISG Ammonium Nitrate (AN) CoP, which are centered on:

- The outcomes of the extensive review of the AN Technical Panel (consisting of AEISG and regulatory representatives), which over the course of approximately 12 months developed the risk-based approach underpinning Tables of Distances (ToD) for typical storage arrangements for AN in Australasia; and
- Consideration of feedback that was provided by regulatory bodies, in response to the preliminary paper.

As is normal practice with the development of AEISG Codes of Practice, any material feedback from regulators is welcomed and addressed wherever relevant in finalising the document to ensure best practice is captured.

2 AEISG AN Code – Why is it required?

AN is not an explosive but is classified, both locally in Australasia and internationally, as an 'Oxidising solid' and a Class 5 dangerous good for transport purposes. Its properties make it extremely useful as a fertiliser and as an ingredient in the manufacture of safer commercial explosives.

Australia is one of very few countries where some explosives regulators stipulate conservative safety separation distances (based only upon the potential consequence of a worst case event) from AN storages, with no consistency between jurisdictions and based upon distance tables, historically developed for explosives (not oxidising solids). The basis for these separation distances is not consistent with modern developments in the use of risk-based assessment, which considers both the probability of an event occurring and the potential consequences of that event.

Conversely, for each of Australia's major AN manufacturing facilities, the relevant (jurisdictional) Major Hazard Facility (MHF) regulator utilises a risk-based assessment approach which is applied to vast AN stores (>>2,500 tonnes). For the most part, AEISG members are focused upon significantly smaller quantities of AN (<=1,000 tonnes) at approximately 200 sites with the majority of storages at mine sites. It needs to be noted that in most jurisdictions the regulator responsible for AN and the MHF regulator are units within the same agency.

Given the inconsistent and confusing regulatory approach by jurisdictions to the storage of AN, AEISG in 2016 commenced a project to develop a transparent and technically valid guide, specifically for AN storage and handling. All relevant regulatory bodies have been kept advised of this project and the principles upon which the guide will be based. Some regulators agreed to work with AEISG in developing the initial draft and participating in an AN Technical Panel.

This project is now at practical completion, with the end result being the publication of an AEISG Code of Practice - 'Storage and Handling of Solid Ammonium Nitrate', which when published will require mandatory compliance by all AEISG member companies, in addition to any local legislative requirements. As with all other AEISG Codes of Practice, many of which have been referenced in existing legislations or been accepted by regulators as 'Approved codes', the expectation of AEISG is that the AN Code will have significant flow-on benefits to relevant regulatory bodies and the communities that they seek to protect.

3 AEISG AN Code - Development

In developing this Code, AEISG has drawn on the knowledge and experience of its member organisations, many of whom have a global presence. The starting point was to review, compare and evaluate all the globally available "guides" (i.e., standards, codes, guides, etc) to which members have access. This review and evaluation included not only "what" the guides say, but also "why" they say it.

The points of similarity across these guides generally concern precautions against fire, precautions against contamination or accidental mixing, the need for security, and numerous "general" requirements applicable to many types of site (systems, procedures, environmental impact, worker safety, etc). An unintended point of similarity is that most are ambiguous or unclear in parts.

The points of difference generally concern site location and what (if any) separation distances should be in place around AN storage, where the divergence in approaches range from the most common "no separation required, but consider toxic fumes if there's a fire", through to the (very rare) "mandatory Quantity Distances (QDs) as if AN is Class 1 explosives".

Arising from the review and subsequent consideration, AEISG made several key policy decisions about this Code:

- i. **Clarity:** AEISG's intent is that this Code will be clear, unambiguous and transparent, with each requirement specifically intended to lead/contribute to a particular desired outcome.
- ii. **Narrowed Scope:** this Code is deliberately focused only on stores used as part of the commercial explosives industry, located typically at consumption sites (mines and quarries) plus some distribution hubs (e.g., transport contractor stores). The scope of this Code has therefore been narrowed significantly compared to all other AN codes known to AEISG members, as it includes only two types of solid AN (i.e., UN 1942 and UN 2067), and excludes (broadly): fertilisers, manufacturing (of AN or any downstream product), transport, transit storage, wharves, and some specialised situations (e.g., storage in underground mine workings).
- iii. **Adopt common requirements:** In principle, requirements and recommendations which are the same or similar across multiple guides, and where the intent is clear, have been adopted.

- iv. Adopt best practice Environmental Guidelines:** AEISG worked closely with environmental agencies to develop and include best practice guidelines to minimise adverse environmental impacts during all phases of establishing, locating and operating an AN store.
- v. Store Location:** In the absence of any significant commonality of approach globally, AEISG has decided that the basis for deciding the acceptability of a storage location should be risk - that is, the presence of the store must not generate an unacceptable level of risk to surrounding land uses.
- vi. Risk Targets:** for the purpose of store location, AEISG has adopted as mandatory the individual fatality risk (IFR) targets applicable to specified land uses as detailed in the NSW Hazardous Industry Planning Advisory Paper No. 4 – “Risk criteria for land use safety planning” January 2011; New South Wales Department of Planning (HIPAP 4).
- vii. "Default" Separation Distances:** Given the significant commonality of in-scope (this Code) Australasian AN storage sites, AEISG determined that carrying out a site-specific risk assessment for every AN site would not provide material value-add given the likely inefficiencies and inconsistencies for conducting risk assessments for approximately 200 in-scope AN sites; AEISG member organisations have differing risk assessment processes and no two Australasian regulatory jurisdictions have a consistent process for determining the appropriateness of an AN storage site, particularly in determining site location and required separation distances. Much of the work AEISG has done in developing this Code has therefore been to develop a methodology through which (conservative) "default" separation distances could be established, so that for a typical type of store (e.g., a metal shed) the distance required to surrounding land uses can be 'looked up' in a table, rather than worked out from scratch. This methodology has allowed the development of ToD, where the distances specified will ensure that the IFR at surrounding land uses does not exceed the HIPAP 4 criteria. This approach is at least in part enabled by the narrowed scope of this Code, which reduces variability in storage configuration and makes a "generic" approach feasible.
- viii. Technical Panel:** Many "technical" decisions are inevitably required to produce a Code, and AEISG formed a Technical Panel to take the role of technical decision making (including reviewing and endorsing any technical decisions made by authors or sub-groups). All relevant regulatory bodies receiving AEISG's AN 'Proposal Paper' (August 2020) were invited to participate in this panel, along with AEISG members. The Panel (consisting of AEISG and regulatory representatives) was formed in late 2020 and has been active since then.

4 Methodology for Default Separation Distances

- Risk targets and land uses - from HIPAP 4.
- Types of AN Store (Potential Explosion Site (PES)): 5 representative types were selected by the AN Technical Panel.
- Types of Exposed Site (ES): 5 representative types of physical construction which may be used for various land uses around an AN store were selected by the AN Technical Panel.
- AN explosion mechanisms and contributions - from “Good Practice Guide: Storage of Solid Technical Grade Ammonium Nitrate” (GPG 02 rev02, March 2014) published by SAFEX International (SAFEX GPG).

- AN explosion consequences (i.e., likelihood of fatality at an exposed site): assessed using the AN module of the IMESA FR blast-modelling software.
- AN explosion likelihood: estimate is based on consideration of four sources:
 - Typical estimates that have been used in Quantified Risk Assessment (QRA) involving AN;
 - The baseline event frequencies and allowable reductions detailed in the SAFEX GPG;
 - The frequencies determined by the IMESA FR Technical Panel, and which appear as the IMESA FR defaults; and
 - AEISG's own "ground up" estimate.
- Modelling process: defined so that any qualified and licensed user of IMESA FR can reproduce the ToD.
- Default distances are grouped within five ToD, corresponding with the five representative types of AN store construction.
- Each ToD specifically considers the five land uses defined in HIPAP 4. The default distances are conservatively set to meet at least the risk criteria in HIPAP 4.
- The ToD are based on assessment of both "open" land uses, and any of four typical types and sizes of building construction at surrounding land uses where people may be present and exposed to risk from an AN store explosion. The ToD cover any type of construction within or reasonably similar to any of these four types. If there are any ES structures which are not reasonably similar then the tabulated distances may not apply and a site-specific assessment may be needed.
- IMESA FR modelling assumes all PES are always filled to full licence capacity, and all exposed sites are continuously occupied.
- The Code includes guidance on evacuation (which is mandatory if a fire is out of control) - but the fixed separation distance requirement of this Code apply regardless of whether evacuation is credible, i.e., there is **no reliance on evacuation** and risk targets are met on that basis.
- Calculation of explosion effects is based upon an explosion of the maximum capacity of the store, unless the stored AN is divided into stacks or piles separated in accordance with the SAFEX GPG.
- For high population densities, an additional assessment of societal risk may be necessary.
- The Code provides clarity on the approach used, including:
 - details of the PES and ES construction and other factors included in the IMESA FR modelling;
 - guidance on evacuation distances;
 - guidance for use in any site-specific QRA;
 - specific guidance on the conservative parameters / inputs that should be considered for use in a site-specific risk assessment utilising the AN Module of IMESA FR.
- The Code specifies the process, and provides flowcharts, to be used in situations where AN storage is in proximity to Class 1 Explosives or ANE.

5 Other Fundamentals of the AEISG AN CoP

- Applies to AN meeting the requirements of UN 1942 and UN 2067, and storages specifically aligned with the commercial explosives industry.
- Utilises a risk assessment approach in the development of conservative "default" site separation distances for AN storage, ranging from 1 to 1,000 tonnes.

The extensive risk analyses carried out by AEISG in developing acceptable separation distances for this Code identified, or confirmed, that the application of typical QD tables for AN stores:

- Does not take into account the type of structure at an ES;
- Does not take into account the different risks posed by different AN storage types (PES);
- Does not specifically take into account projections or shrapnel or the directionality thereof;
- Does not provide or ensure an acceptable level of risk, particularly at lower quantity storages;
- Is excessively conservative at larger quantity storages leading to unnecessary restrictions on neighbouring land uses.
- Does not require AN to be treated as "equivalent" amount of TNT (a subject on which there are many opinions but little agreement) since AN explosions are modelled directly as AN (a benefit of using the IMESAFR AN Module).
- The relevant ToD applicable to the type of proposed storage shall be applied by AEISG member organisations, otherwise a site-specific risk assessment must be conducted.
- The Code is not retrospective.
- Any AN store shall not be put into operation before all required licences or other formal approvals from relevant regulators have been granted.

6 Beirut Tragedy

Rare events such as the Beirut tragedy (2020) have resulted in some Australasian regulatory jurisdictions continuing to take an ultra-conservative approach to the storage of AN, akin to explosives. AEISG acknowledges that AN was stored in large quantities in Beirut, however the virtually non-existent safety management systems and practices that allowed the co-storage of fireworks and combustible products within the same warehouse, are in no way comparable to the levels of operational safety that have been established, and continue to apply, both in Australia and New Zealand.

The Beirut tragedy, although relevant to the topic of this Summary Paper, gives rise to no new "technical" learning. This tragic explosion does, however, give added point to the need for appropriate and uniform standards for safe and secure AN storage and handling, and AEISG is confident that the AEISG Code, if implemented, could have prevented the Beirut (and many similar) tragedies.

7 Conclusion

To manage the risk arising from a potential explosion of AN, the Code has adopted the hierarchy:

- i. Ensure the likelihood of any explosion is reduced to as low as reasonably practicable;
- ii. Ensure that AN storage is appropriately located, i.e., there is sufficient separation distance to achieve the HIPAP 4 IFR criteria; and
- iii. Ensure that in the event of conditions which potentially could lead to an explosion, a well-thought out evacuation is carried out.

The methodology developed, and the resulting separation ToD, make it possible for AEISG members, and others involved in the explosives sector, to establish AN storage sites without the need for a site-specific QRA. Through assessing hazards and risk in a conservative manner, the Code delivers community safety in a consistent and efficient way for most proposed AN stores, with very few exceptions (i.e., those above MHF thresholds and those not reasonably fitting within the limits detailed in the Code). Such exceptions need site-specific risk assessment, and the Code recommends a methodology for the conduct of any such assessment.