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Dampier fact sheets

Introduction

The Dampier Archipelago consists of 42 islands and islets close to the western coast of Australia, about 1600 km north of Perth. They vary greatly in size, ranging in land area from 1 ha to 3290 ha. The largest island, Murujuga, was separated from the mainland only by tidal mud-flats and connected to it by a causeway built in 1964. Called Dampier Island until 1971, it was then renamed Burrup 'Peninsula' after a Roebourne bank clerk. Murujuga is maximal about 27 km long and up to 5 km wide, measuring about 117 km^2. The Archipelago was named after William Dampier, thought to be the first European captain to see it. Until 1868, most of it was occupied by the Yaburrara, a sub-tribe of the Ngaluma, and frequented by the Ngaluma, Mardudhunera and other tribes of the region. In 1868, the Yaburrara were subjected to almost complete genocide by the colonial government, in a series of horrific massacres occurring over about three months.

The Dampier Archipelago is regarded as containing the world's largest concentration of rock art, comprising at least 600 000 petroglyphs, and very probably well in excess of one million motifs. It also features Australia's largest corpus of stone arrangements, of which five types occur, numbering in the thousands. It is estimated that the rock art and megalithic structures occupy a total area of at least 8 km^2, and this is therefore the world's largest art gallery, and

Figure 1. *The central part of Murujuga (Burrup 'Peninsula') showing part of the industrial complex. Rock art and stone arrangements occurred throughout the area prior to the 1960s, but have now been destroyed in much of it.*

Australia's largest cultural monument.

Between 1963 and 2004, about 900 rock art sites of the estimated total of 3690 sites on Murujuga (Burrup) have been destroyed by development (Legislative Council 2005). This represents 24.4 % of the island's total rock art. A similar proportion of the stone arrangements has also been sacrificed to development. The remaining rock art of the Archipelago is being subjected to slow and gradual destruction through the massive acidic industrial emissions of the petrochemical plants that have been placed there since 1980 because of a series of planning bungles by the government of Western Australia. The most serious aspect of these is the establishment of very large volatile installations in close proximity. The petrochemical precinct of Dampier measures only a few square kilometres, yet the state government intends to cram numerous more plants into this area, in addition to the existing explosive storage there.

The explosive energy stored at Dampier

Existing installation at Northwest Shelf LNG facility at Dampier

4 LNG tanks, each of 65 000 m^3, total 260 000 m^3
2 Condensate tanks, each 72 000 m^3, total 144 000 m^3
2 Condensate tanks, each 90 000 m^3, total 180,000 m^3
1 Propane tank, 52 000 m^3
1 Butane tank, 65 000 m^3

The LNG is stored below its boiling temperature of -161º C, condensed 600 times. Therefore these 4 tanks have a capacity of 156 000 000 m^3 of methane. One m^3 of methane represents 37 080 BTUs (British Thermal Units) of energy, therefore these 4 tanks contain 5 784 480 000 000 BTUs when full.

One tonne of TNT yields 1 000 000 000 calories, or 3 968 321 BTUs. Therefore one Hiroshima-size atomic bomb, which is 15 kilotonnes of TNT, represents the energy of 59 524 815 000 BTUs. It follows that the LNG stored in the four existing LNG facility represents up to 97.2 atomic bombs of the size of the Hiroshima *Little Boy* bomb of 6 August 1945. Since there is also massive energy stored in the remaining 6 tanks, the minimum explosive energy held at the facility can be assumed to total at least the equivalent of 100 Hiroshima bombs, or the equivalent of 1 500 000 tonnes of TNT, at any given time.

Planned initial capacity of the Pluto facility

2 LNG tanks, each 160 000 m^3, total 320 000 m^3
2 to 3 Condensate tanks, total 120 000 m^3

The 2 LNG tanks are planned to have a capacity of 192 000 000 m^3 of methane, or 7 119 360 000 000 BTUs (Woodside 2006). This therefore corresponds to another 119.6 Hiroshima bombs, excluding the condensate, propane, butane, light oil and hydrogen tanks. Depending on how full the tanks are, it can be assumed that the minimum equivalent of 120 Hiroshima atomic bombs (1 800 000 tonnes of TNT equivalent) will be stored there at any given time. It is planned to locate the Pluto plant next to the existing Northwest Shelf LNG plant.

Other volatile installations at Dampier

At the port of Dampier, next to the proposed site of the Pluto plant, 92 000 000 tonnes of ammonium nitrate is stored according to a newspaper report (*The West Australian* 2004). This chemical can explode spontaneously, particularly in hot and humid conditions (Touluose disaster, 21 September 2001).

In 2005, the Burrup Fertiliser plant, 1 km east of the Port, commenced production. Its storage tanks also contain massive quantities of several volatile, toxic, flammable and explosive substances.

The size of the Dampier bomb

On this basis it can be reliably estimated that the combined energy stored in the Northwest Shelf, Pluto, the Port and Burrup Fertiliser facilities at any given time would be at least 4 000 000 tonnes of TNT equivalent, or 267 Hiroshima bombs (assuming Pluto is placed at Dampier). These plants are within a few hundred metres of each other, and if one of them exploded, the others would suffer the same fate.

Previous LNG disasters

Liquefied natural gas terminals present low-risk, high-consequence potential of major disaster. Thousands of people have died directly in LNG and natural gas explosions, tens of thousands have been injured or suffered gas poisoning. If there were a major mishap at Dampier, it is likely to kill 10 000 people immediately, through asphyxiation, explosion or fire. The most recent LNG disasters were the following:

Southern Ural Mountains, Russia, June 1989: 575 killed, over 700 injured.
Chongqing, south-western China, 23 December 2003: 234 workers killed, over 500 injured, 9000 residents poisoned, 40 000 evacuated.
Skikda, eastern Algeria, 19 January 2004: 27 workers killed, 72 injured (Halliburton had updated the plant in 1999).
Ghislenghien, Belgium, 30 July 2004: 23 killed, more than 120 injured.

The future disaster at Dampier

Assuming that (because of terrorist attack, earthquake, helicopter accident, lightning, faulty equipment, the act of a deranged employee or any other reason) a tank at Dampier has been damaged, the following scenario is to be expected.

The liquid LNG, which consists almost entirely of methane, has a specific gravity of 1.5 and will on exposure to air boil over, much as boiling water does, rapidly expanding in volume and fracturing steel structures in its way through its extreme cold. Being at this stage much heavier than air, non-inflammable and non-explosive, it will flood the plant and flow to any low-lying areas, including the nearby sea. At the periphery of the developing methane cloud, where adequate oxygen is available, a flame membrane will heat up the methane and explode other tanks as the cloud expands. The rapidly forming cloud will be white, because air moisture would condense to water vapour through the cold methane. It will expand up to 600 times the volume of the

Figure 2. *Destruction of rock art site for road fill, on 30 May 2006, near Dampier Port.*

tanks and blanket the surrounding land for many kilometres, with an eventual volume of around 400 cubic hectares (e.g. covering an area of 200 km^2 or 16 km diameter 2 m deep). The rate and direction at which the methane diffuses depends primarily on the air temperature, air turbulence, and direction and strength of the wind. When the gas reaches its Lower Explosive Limit (mixed with air 5–14 % by volume), it is highly explosive, and ignition will occur at the periphery of the cloud almost as soon as the disaster occurs (e.g. from a flame tower, the initial explosion or any other potential source). The heat generated would be in the order of 2000–3000º C, first destroying the tensile strength of any steel (at 1200º C), then melting it (at 1600º C). As the methane cloud expands towards Dampier and Karratha, all living organisms, from humans to bacteria, will be first asphyxiated and frozen, then burnt. For many kilometres around the cloud, oxygen would be severely depleted as it is sucked into the firestorm, and where it's level falls below 6 %, convulsions and death would occur in humans and other mammals. At levels of between 6–10 %, loss of consciousness would occur, and symptoms such as impaired respiration, permanent heart damage, nausea and vomiting would be still registered at 12.5 % (the normal oxygen content of air at sea level is 20.9 %). As the enormous quantities of methane burn, the population of Dampier and Karratha would probably perish even if not reached by the burning cloud, through oxygen depletion around the cloud. A methane cloud can travel for many kilometres, even hundreds of kilometres, especially unignited.

In addition to these immediate primary effects, other effects of such a disaster would include the complete destruction of all Burrup industry, including that of Hamersley Iron/Rio Tinto, the harbour, and all jetties and ships in the area. The immediate damages would be well in excess of $30 billion, but the long-term damage to the economy of Australia would be far greater. It would include the effects of a complete collapse of the LNG network of Western Australia, and the loss tax revenue, international sales and markets, labour redundancies across the state, losses to contractors and suppliers, and compensation claims from dozens of iron ore, salt and LNG customers throughout the world. The disaster would also cause the breakdown of the state's electricity grid (as gas-powered generators would be shut down indefinitely), and the cost of disaster relief and long-term social security needs. Thus the total cost can be safely assumed to be in the order of 10 000 human lives and hundreds of billions of dollars to the economy. The reason for this, the greatest industrial disaster in human history, is the insistence of the government to place all these volatile plants, which present ideal terrorist targets, in one single location, thus creating the 'Dampier bomb'.

In addition to the devastation of the Dampier industrial complex and the state's economy, a major explosion at Dampier could also cause a tsunami that would affect the west coast of the continent and southern coasts in the Indonesian archipelago.

The emissions of Dampier industry

Woodside's Northwest Shelf facility, 2004/5

Nitrogen oxides: 12 000 000 kg
Benzene: 1 200 000 kg
n-Hexane: 2 000 000 kg
Toluene: 2 200 000 kg
Total of organic compounds: 33 000 000 kg
Carbon monoxide: 2 500 000 kg
Carbon dioxide: undeclared, but believed to be between 8–12 000 000 000 kg per year.

Previously claimed emissions of NO_x were: 1 300 000 kg in 1999, 6 800 000 kg in 2000, 5 800 000 kg in 2001, 11 000 000 kg in 2002, 12 000 000 kg in 2003 and 2004.
Of benzene, they were: 130 000 kg in 1999, 1 200 000 kg in 2000, 1 100 000 kg in 2001, 1 000 000 kg in 2002, 780 000 kg in 2003, 880 000 kg in 2004.

The production of the facility has steadily increased over these years, therefore the severe irregularities in some of these quantities need to be explained. In March 2003, Woodside admitted that it had lied about the NO_x quantity, which explains the doubling in the 2002 report. The 1999

Figure 3. *Hilltop with part of a stone arrangement, as photographed in late 2005, which features on the cover of the book* Australian Apocalypse. The story of Australia's greatest cultural monument.

values are also entirely unrealistic and the benzene quantities remain probably false. The facility has been Australia's largest air polluter for over 25 years (Australian National Pollutant Inventory 2006).

Other industry

The Hamersley Iron/Rio Tinto facility at Dampier reports emitting 7 000 000 kg of particulate matter (<10 μm), but only minor quantities of other pollution. There are no details yet available from Burrup Fertilisers, which commenced production recently. If the Pluto plant were established at Dampier, the crucial emissions of NO_x and benzene would more than double relative to present levels.

The effects of the Dampier emissions

The greatest concern for the local population are the organic compounds emitted by the petrochemical industry. They are the highest at any Australian site, and the most damaging of them to human health is the benzene. Woodside admits to emitting 40 times as much benzene as the Shell refinery at Geelong, Victoria, to which several deaths through leukaemia have been attributed. Benzene is a carcinogen that has been shown in clinical tests to cause Acute Myelogenous Leukaemia, Acute Lymphatic Leukaemia, Chronic Myelogenous Leukaemia, Chronic Lymphatic Leukaemia, Hodgkin's Disease and Hairy Cell Leukaemia. It is also recognised as a developmental and reproductive toxicant. Long-term exposure can affect normal blood production and can be harmful to the immune system. Benzene has been linked with birth defects in both animals and humans. All organic compounds emitted by Woodside's plant, 33 000 tonnes of them, are also harmful to humans. They will at least double if the Pluto plant is established at Dampier.

The greatest concern for the preservation of the rock art of Dampier are the acidic emissions, most especially the oxides of nitrogen. They form nitric acid on contact with moisture, which then leaches the principal cations from the mineral accretion covering all rock surfaces, particularly iron and manganese. This results in the bleaching of this patina, which has taken many millennia to form and which is very sensitive to reduction of precipitation pH. The gradual but eventually complete destruction of the petroglyphs is rendered inevitable by this process. Deterioration of the mineral crust has been measured since the late 1960s, and has accelerated significantly since the late 1980s (Bednarik 2002). The Dampier emissions are recorded as light to medium, sometimes heavy rainfall on the local rain radar facility every day of the year, even if there are no clouds within a thousand kilometres. It is predicted that the rock art will begin to disappear during the present century, just as its makers did during the 19th century. The acidification of the natural environment also has other consequences, among them the destruction of the nearby coral reef and other components of the delicate environment.

Summary

There are numerous other concerns for the cultural precinct of Dampier, especially the ongoing physical destruction of rock art and stone arrangements, which began in 1963, has continued every year since then and remains ongoing. Major components of the monument have been destroyed as recently as May 2006, and the placing of the Pluto plant at Dampier will destroy most remaining rock art and stone arrangements between King and Withnell Bays. The continuing lack of a comprehensive management plan, the lack of any protection of the monument from uncontrolled

Figure 4. *The hill depicted in Figure 4, almost completely bulldozed in May 2006 to make room for a tourist access road. The stone arrangement and rock art were completely destroyed.*

visitation, and the endemic lack of competence in heritage management in Western Australia are further concerns.

The government's lack of concern over the extremely high level of carcinogenic emissions is likely to lead to major compensation claims in the long term. The government's determination to add significantly to the already dangerously high concentration of toxic, volatile, flammable and explosive stockpiles at Dampier is particularly hard to understand. It indicates an inability to comprehend the severity of these planning mistakes. There are numerous alternative sites available for all future developments along the coast, and the need for such alternative industrial nodes is in any case inevitable. There is thus no need to prolong the destruction of the Dampier Cultural Precinct any further. Only one factor prevents the state government from discontinuing the destruction of the Dampier monument: its unwillingness to concede that its decision to allocate $185 million to infrastructure at Dampier was a mistake. Nearly all industrial proponents have now rejected Dampier as a viable site for their developments, including BHP Billiton, Methanex, Syntroleum and DME Japan, and no new ones are likely to be lured to Dampier. The Gallop plan for Dampier is a disaster in every possible sense.

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