A case study - Cyclone Evacuation in the Timor Sea

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SUMMARY

Nexus Energy (Nexus) is the operator of the ACP23 permit in the Territory of Ashmore Cartier in the Timor Sea. The permit contains the Crux gas and condensate field. During March 2007, Nexus was undertaking drilling operations at the Crux field using the semi-submersible drilling rig Songa Venus, operated by Songa Drilling. Nexus utilised the Truscott Airbase to land fixed wing aircraft from Darwin, and then flew helicopters from Truscott out to the rig. An incident occurred as a result of failing to completely down-man the Songa Venus in the face of approaching Tropical Cyclone George. The National Offshore Petroleum Safety Authority (NOPSA) issued an Improvement Notice to Songa as the Rig Safety Case owner. Nexus was responsible for providing aviation transport and logistics. The evacuation planning allowed for a 12 hour buffer. Nonetheless, rapid changes in weather resulted in this buffer time being inadequate. On the morning of the planned final evacuation flight, the Bureau of Meteorology (BOM) issued a forecast of cloud base below the aviation alternate minima for Truscott (1,079 ft above ground level and 4.4 km visibility). The weather forecast of the cloud base minima being predicted to be below the aviation alternate minima invokes an aviation regulatory rule. This aviation regulatory rule requires that a suitable onshore alternate landing site is available before the helicopter is allowed to take off. The designated alternate landing point at Troughton Island was predicted to be similarly affected by weather and not suitable as an alternate landing point. The selected alternate landing site cannot then also require an alternate. Therefore, the helicopter was not able to take off and the flight to the rig was consequently aborted leaving 17 people onboard the rig.

Nexus has since dedicated significant effort and resources to rectifying the situation that occurred. Nexus plans to develop the Crux field and therefore must find a reliable solution for future cyclone evacuations. Nexus undertook an extensive review of regional alternate landing sites relevant to Truscott airbase and Crux. The most viable and reliable options for the Crux field were assessed as Cape Leveque and Kupang, West Timor.

Along with other technical solutions, Nexus has funded the upgrade of the existing Truscott BOM weather station facilities to an Automatic Weather Information System (AWIS), which will be operational for the 2007/08 cyclone season. The AWIS includes: a ceilometer that measures cloud base minima, a vis-meter that measures cloud cover, and an air pressure sensing pparatus (QNH). This information is measured and transmitted in real time to aviator operators. The documented height above the runway designated as the alternate minima is determined by the height of the surrounding terrain. The philosophy behind the lowering of the alternate level, when AWIS information is available, is based upon the flight crew being able to accurately set a known current QNH reading onto an altimeter sub scale, thus increasing altimeter integrity.

The improved weather measurement information has allowed for a 100 ft reduction in approach and alternate minima for the airbase. This is of potentially significant benefit given that the incident described in this paper was directly related to the inability of the helicopter to take off from Truscott due to restrictions on alternate minima. In addition, the installation of the AWIS will allow for more accurate weather forecasting for Truscott and the region.

A key outcome of the assessment undertaken was to improve the definition of the tasks that need to be undertaken for cyclone emergency planning, and clearly assign these tasks to positions in the emergency response team. The revised emergency response team is comprised of three key roles: cyclone evacuation coordinator; transport coordinator; and aviation technical advisor.

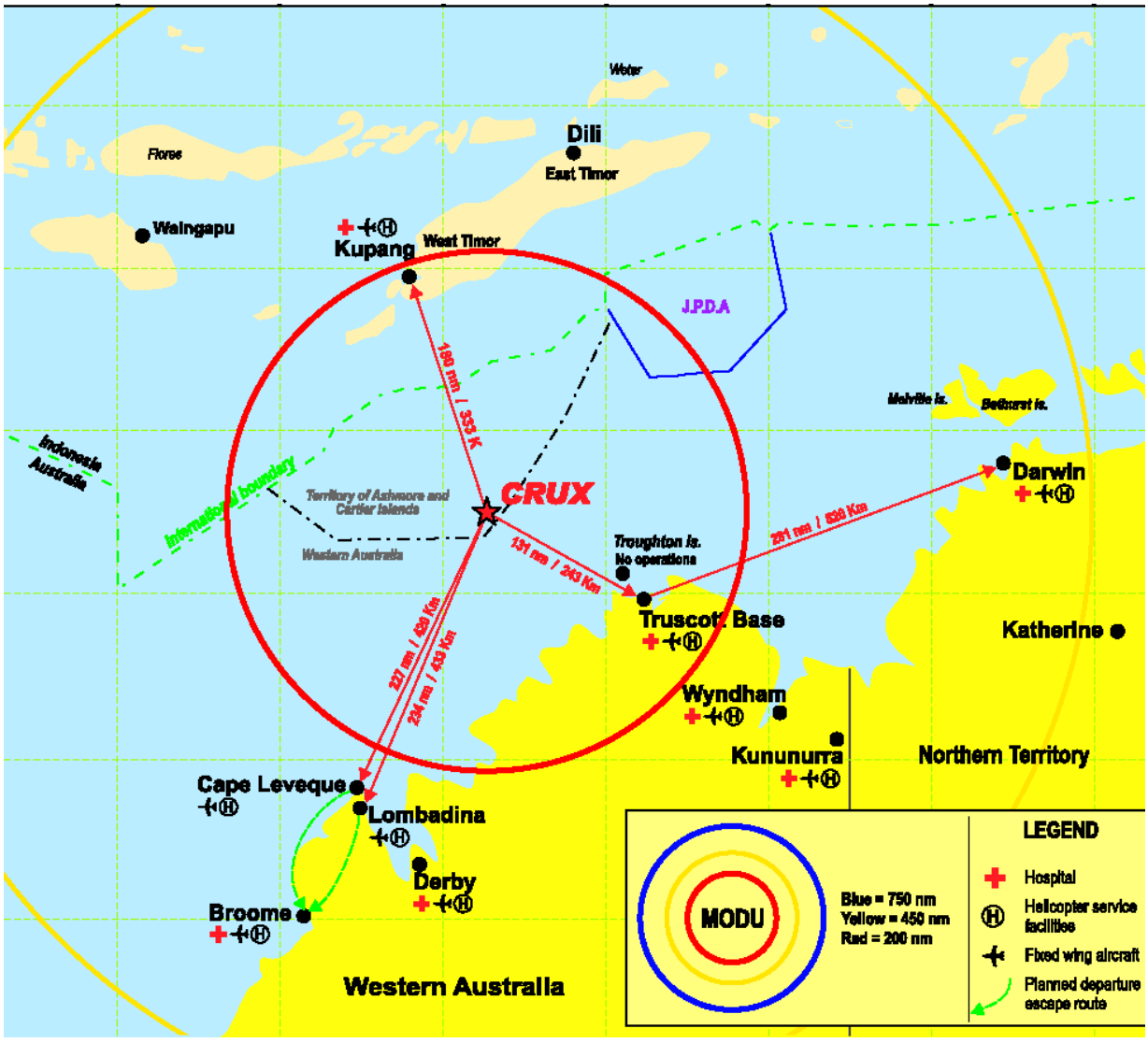
The cumulative effect of multiple operators working in the region needs to be assessed on an ongoing basis. Substantial improvements can be made to cyclone evacuation infrastructure and resources via an industry-wide approach.

INTRODUCTION

Background

Nexus Energy (Nexus) is the operator of the ACP23 permit in the Territory of Ashmore Cartier in the Timor Sea. The permit contains the Crux gas and condensate field (Fig. 1). During the drilling operations at the Crux field in March 2007, Nexus utilised the *Songa Venus* drilling rig and the Truscott Airbase as the fixed and rotary wing staging base. An incident occurred during the approach of Tropical Cyclone George whereby the final crew remaining on the drilling rig were not able to be evacuated. As a result, Nexus initiated a case study on the failed evacuation to identify options and improvements to ensure the success of future cyclone evacuations. Nexus intend to develop the Crux field utilising a permanently moored Floating Production, Storage and Offloading (FPSO) vessel, such that it is critical that cyclone evacuations are able to be planned and executed in a reliable manner.

Figure 1. Location of the Crux field in the Timor Sea



Incident Investigation

International Safety and Risk Management (ISRM) was appointed by Songa Drilling and Nexus as an independent party to investigate the failed down-manning incident. Four evacuation flights were

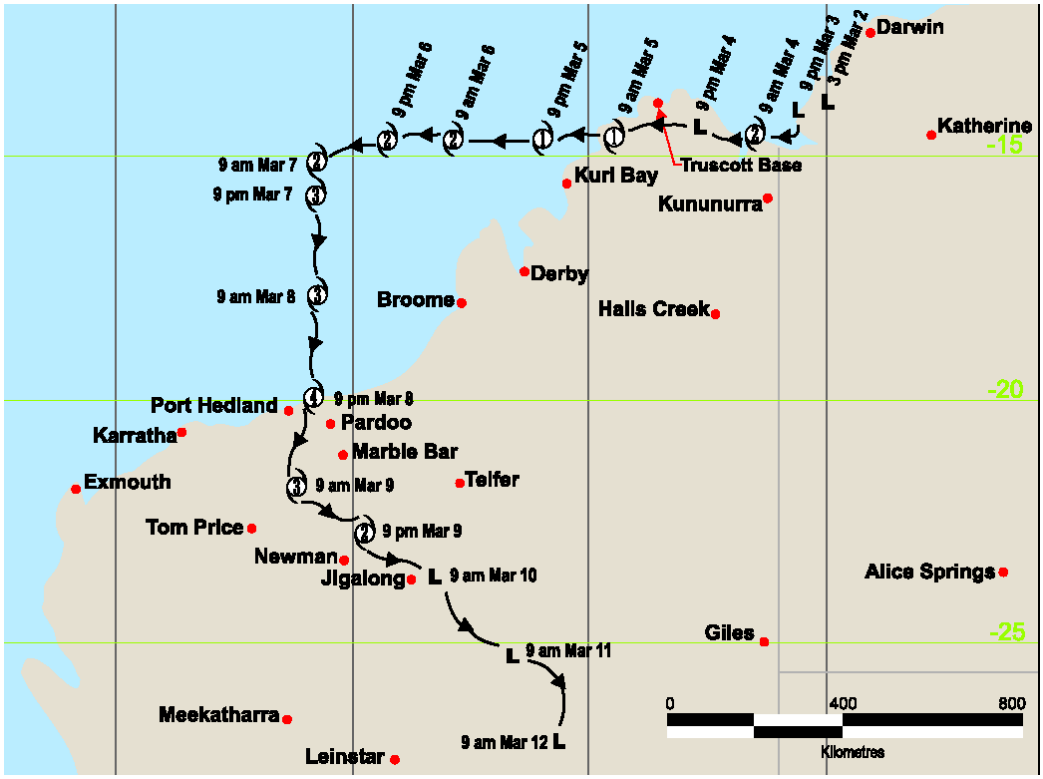
successfully carried out with one crew of personnel remaining on the rig performing rig securing operations. Evacuation planning allowed for a 12 hour buffer between the approaching cyclone winds impacting the rig. Rapid changes in weather and poor monitoring protocols resulted in the buffer being eroded and ultimately being inadequate.

On the morning of the 4 March 2007, the Bureau of Meteorology (BOM) forecast that the cloud base at Truscott Airbase was to be below the aviation alternate minima. In this situation, aviation rules require that a suitable onshore alternate is available before the helicopter can take off. Troughton Island was the designated alternate. Due to its relatively close proximity to Truscott (approximately 24 nm), Troughton was forecast to be similarly affected by low cloud cover and was, therefore, also deemed to be unavailable as a suitable alternate landing site. The alternate landing site cannot also require an alternate. Therefore, in accordance with aviation regulatory requirements, the helicopter operator was unable to take off from Truscott to the rig without a suitable onshore landing alternate. Consequently, the final evacuation flight to the rig had to be aborted, leaving 17 personnel onboard.

Tropical Cyclone George passed over Truscott and moved westwards away from the rig, with the weather at the rig remaining relatively stable (see Fig. 2). NOPSA issued an Improvement Notice to Songa Drilling as the designated operator of the Rig Safety Case. Nexus acknowledge their responsibility in the incident as the coordinator of aviation transport and logistics.

The findings of the investigation indicated that no single event led to the incident—a number of causal factors leading up to, and during, the evacuation contributed to the incident outcome. In the final analysis, it was determined that the incident was unlikely to occur had appropriate steps been taken during the pre-planning stages to fully explore all possible restrictions and options. The investigation identified a number of corrective actions with the most significant of these being described in the remainder of this paper.

Figure 2. Historical Trajectory Path of Cyclone George



The improvements and corrective actions taken are discussed under four main headings: Technical solutions; Cyclone evacuation protocol; Assessment of alternate landing Sites; and, Industry-wide coordination.

TECHNICAL SOLUTIONS

One of the primary issues identified during both the incident investigation and follow-up work was the historical and potential impact of weather on the aviation base itself, the offshore rig/facility itself and the nominated alternate landing locations. Potential weather related impacts include:

- rapid change of weather pattern impacting on the suitability or ability to use primary locations;
- inability to use primary or alternate air bases due to forecast cloud cover or cloud base minima; and,
- conservatism in weather forecasts due to having to interpolate data sourced from weather stations located at significant distances.

Along with other technical solutions, Nexus has funded the upgrade of the existing Truscott BOM weather station facilities to an Automatic Weather Information System (AWIS). The AWIS includes a ceilometer that measures cloud base minima, a vis-meter that measures cloud cover, and an air pressure sensing apparatus (QNH). This information is measured and transmitted in real time to aviator operators. The AWIS will be operational for the 2007/2008 cyclone season.

The documented height above the runway designated as the alternate minima is determined by the height of the surrounding terrain. The philosophy behind the lowering of the alternate level, when AWIS information is available, is based upon the flight crew being able to accurately set a known current QNH reading onto an altimeter sub scale, thus increasing altimeter integrity.

The improved weather measurement information has allowed for a 100 ft reduction in approach and alternate minima for the airbase. This is of potentially significant benefit given that the incident described in this paper was directly related to the inability of the helicopter to take off from Truscott due to restrictions on alternate minima. The pre-upgrade and post-AWIS upgrade approach minima are: 679 ft (above ground level—AGL) and 579 ft (AGL) respectively. The pre-upgrade and post-AWIS upgrade alternate minima are: 1,179 ft (AGL) and 1,079 ft (AGL) respectively.

Following the AWIS installation, the resultant improvement is that weather forecasts for cloud base minima can be an additional 100 ft lower (1,079 ft) before the requirement for an alternate landing site is invoked. The AWIS upgrade should allow helicopters to depart Truscott in most circumstances as the requirement for an alternate landing site is much less likely to be invoked.

In addition to the improvements for the Truscott approach and alternate minima noted above, the weather forecasting is likely to be more accurate as the data being used is taken from real measured data at Truscott. There is also likely to be less conservatism in the weather forecasting.

Nexus is also working with Air Services Australia to investigate the benefits, cost and timing of a Global Positioning System (GPS augmentation system, for example GRAS or GBAS). Air Services are considering using Truscott in their initial trial and rollout of this technology. The ultimate goal is to ensure a precision approach based on the upgraded GPS technology and to further reduce the approach minima, thereby ensuring Truscott becomes a more reliable landing base. The technology will assist in lowering the approach minimas, however it does not directly lower the alternate minima. To achieve this, the highest obstacle in the area—the Non Directional Beacon (NDB) aerial—would need to be removed. The NDB is considered old technology, but nonetheless aviators in the greater region may wish to continue to use its capability. This is a longer term initiative and would require the agreement of a larger group of stakeholders including other users of the air base (see discussion about industry-wide coordination later in this paper).

The introduction of GRAS or GBAS technology is still in its infancy, however, it is not the only means of reducing the alternate minima. Current GPS approach technology would facilitate this, provided that the crew and aircraft were TSO 145a or TSO 146a approved, a procedure was installed at Truscott, and the NDB aerial was removed.

CYCLONE EVACUATION PROTOCOL

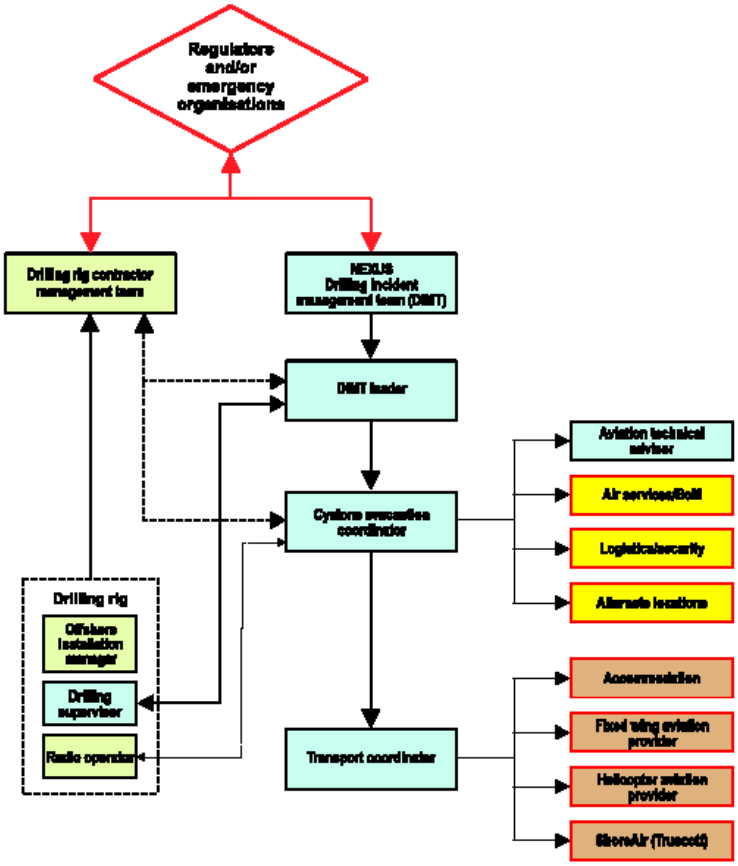
Following the failed evacuation incident and the investigations and assessments that took place after the incident, Nexus has prepared and tested a Cyclone Evacuation Protocol. The Protocol describes the detailed planning and steps to be taken prior to a drilling campaign in the cyclone season, and the procedure to be followed for responding to an approaching cyclone during operational activity. This Protocol has several important components including: roles and responsibilities; communication interfaces; and cyclone evacuation methodology.

Roles and Responsibilities

A key outcome of the assessment undertaken was to improve the definition of the tasks for cyclone emergency planning, as distinct from other emergencies. These tasks then need to be clearly assigned to positions in the emergency response team. The revised emergency response team is comprised of three key roles: cyclone evacuation coordinator; transport coordinator; and aviation technical advisor.

The cyclone evacuation coordinator is responsible for monitoring the weather forecasts on a continuous basis, and undertaking the calculations to determine the point at which evacuation flights need to commence. In consultation with the drilling rig, the coordinator also calculates the number of evacuation flights required, approximate time of each evacuation flight and destination of flights (see Fig. 3).

Figure 3. Communication Interfaces of the Key Emergency Response Organizations



The transport coordinator is the central point of coordination of all flights and supports the cyclone evacuation coordinator in implementation of the flight plan and logistics.

The aviation technical advisor provides technical support and advice to the cyclone evacuation coordinator, including assistance to calculate the evacuation flights and ability to take off and land at primary and alternate air bases.

Communication Interfaces

A key finding in the incident investigation was that it is very important to define the accepted communication pathways and adhere to these. Figure 3 illustrates the main organisations, positions and communication pathways required for the emergency teams. The drilling contractor has the offshore installation manager (OIM) and radio operator (RO) onboard the rig, who are responsible for calculating the time required to secure the rig and sequence of personnel onboard for evacuation. The OIM, RO, and Nexus drilling supervisor need to communicate directly with the Nexus cyclone evacuation coordinator to agree to evacuation timing and flight plans. The evacuation coordinator then communicates with the transport coordinator about the flight plans. The transport coordinator then liaises with the aviation providers to secure the flights in accordance with the flight plans.

Cyclone Evacuation Methodology

The process for determining the relevant timeframe for the activation of evacuation is made by back-calculating the trigger point at which evacuation must commence. This is determined in accordance with the methodology illustrated schematically in Figure 4. The figure shows time as the x-axis, with the cyclone approaching the rig from right to left. The overriding objective of the methodology is to have the final evacuation flight completed by the time the outer edge of the cyclonic winds (greater than 34 knots/hour) are 12 hours from the rig location, which is highlighted as the critical distance. The 12 hours from the rig to the critical distance is assigned the term buffer (B). The total time to evacuate the rig is shown as E. On a case by case basis, the planning also considers other factors that need to be built into a contingency allowance (C). This could include allowance for maintenance, crew hours, and preference to fly only in daylight hours. Therefore, the total planning time required in order to evacuate the rig is the sum of B + E + C, and this defines the point in time at which evacuations must commence. The overall methodology is aimed at being conservative in order to allow for unexpected obstacles, including the significant cumulative effect of multiple operators in the area attempting to evacuate at the same time (see discussion about industry-wide coordination).

ASSESSMENT OF ALTERNATE LANDING SITES

Cyclone Development in the Timor Sea

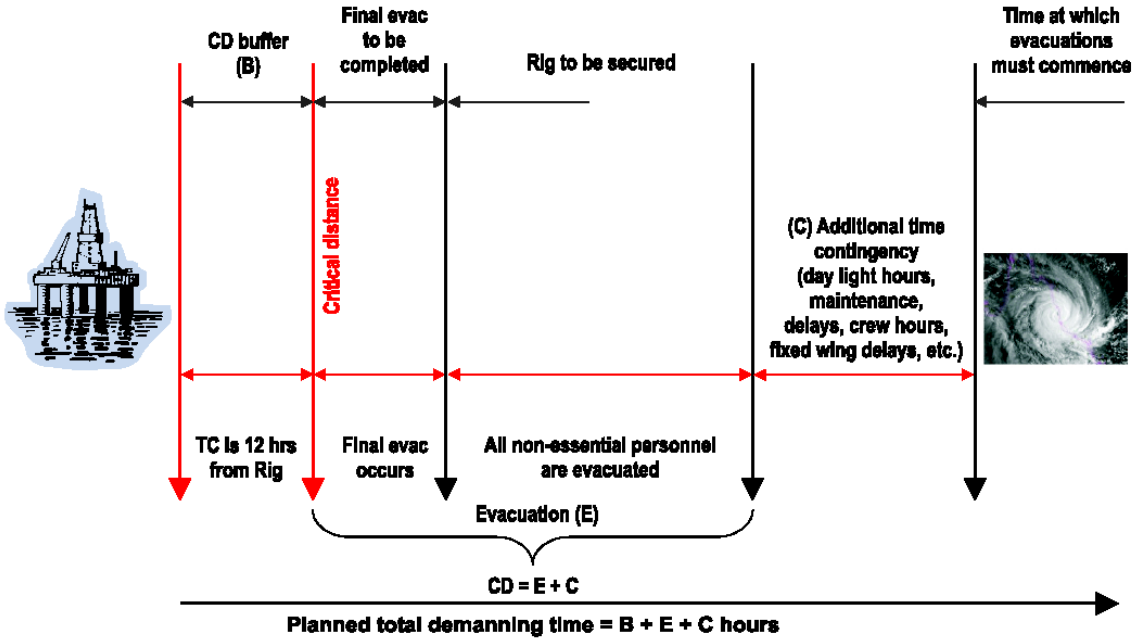
The cyclone season in the Southern Hemisphere is typically November to May. On average, 10 tropical cyclones develop in the Australian region each year, and six cross the coast. In the Crux area, the cyclones tend to form to the north, east or in some cases immediately in the vicinity of Crux. In the case of cyclones developing in the immediate vicinity of Crux, it is not possible to have an evacuation plan spread over many days and based on the cyclone's distance from the rig, since it is already in the critical evacuation zone. Some cyclones develop in Queensland waters and travel eastwards across the Timor Sea and Crux field area, however, it is not possible to accurately predict the movement of a cyclone. Cyclones typically travel between 15 and 25 km/hr.

Assessment of Alternate Landing Options

Nexus undertook an extensive review of regional alternate landing sites relevant to Truscott and Crux. As discussed above, it is possible for the primary landing base to become unavailable due to weather conditions. Given that the direction of approaching cyclones to Crux and Truscott is generally from the north and east, ideally two suitable alternates other than Truscott are required in disparate directions i.e. north and southwest. The alternate needs to be accessible in monsoonal weather, ideally have a useable cloud break procedure/instrument approach, and adequate supporting infrastructure.

Alternates also need to be in close enough proximity to ideally transfer full, or near full passenger loads of around 18 passengers (when utilising a Super Puma helicopter). During cyclone evacuation of the rig crew, it is normal practice to evacuate the non-essential personnel first. The essential crew remaining on the rig need to secure the drilling rig itself and the well bore to ensure no hydrocarbons can escape. Careful judgment is required to evacuate as many personnel as quickly as possible, while still maintaining sufficient crew to adequately secure the rig in a timely manner. Ideally, the final evacuation flight will be 18 people, and preferably less, to maximise the alternate landing site options available. Due to weight load restrictions and increased use of fuel, the further the helicopter must travel to the landing site, the fewer passengers it is able to carry.

Figure 4. Cyclone Evacuation Methodology



The weather forecast conditions can require that helicopters carry additional holding fuel. For example, when extensive cloud cover or head wind is predicted, an additional hour of holding fuel may be required. The additional holding fuel has the knock-on effect of reducing the passenger load due to the need to carry the weight of the additional fuel. Therefore, when examining alternates it is prudent to include in the assessment the effects of the need to carry holding fuel and the consequent reduction to passenger load.

A further consideration in the assessment is the available duty hours for helicopter pilots. Pilots are restricted in the number of hours they can fly on any one day. For longer duration flights, the pilots are likely to have used up their available hours and will be unable to carry out a return flight to the rig to pick up another load of passengers. Unless additional pilot crews are available with spare duty hours at the alternate landing site, the consequence is that the site can only be considered suitable for the final evacuation flight off the rig. The most viable and reliable options for the Crux location were assessed as Cape Leveque and Kupang, West Timor. The results of the assessment are described further below.

TROUGHTON ISLAND

Troughton Island is the primary alternate to Truscott. Troughton Island is not a reliable alternate due to its close proximity to Truscott (24 nm). In cases where Truscott is impacted by poor weather conditions, it is also likely that Troughton Island will be similarly impacted. This was the case with the Cyclone George incident.

KUNUNNURA

Kununnura is 299 nm and approximately 150 minutes flying time southeast of Crux. Where cyclones approach from the east, it may be weather constrained. In a best case scenario, where no additional holding fuel is required and there is no headwind, approximately 14 passengers could be transferred to Kununnura from Crux. In a worst case scenario, where full holding fuel is required and a head wind is present, approximately eight to nine passengers could be transferred. In addition, due to the time required to fly to Kununnura from Crux, it is likely that the duty time for the helicopter pilots would be used up on the flight and they would not have sufficient available hours to undertake a return run. Consequently, Kununnura cannot be considered a reliable alternate for Crux.

DERBY

Derby is 270 nm and approximately 135 minutes flying time south-southeast of Crux. Derby may be in the path of a cyclone approaching from the east or northeast. In a best case scenario, where no additional holding fuel is required and there is no headwind, approximately 14 passengers could be transferred to Derby from Crux. In a worst case scenario, where full holding fuel is required and a head wind is present, approximately nine to 10 passengers could be transferred. Consequently, Derby cannot be considered a reliable alternate for Crux.

BROOME

Broome is 327 nm and approximately 164 minutes flying time south-southwest of Crux. In a best case scenario, where no additional holding fuel is required and there is no headwind, approximately 13 passengers could be transferred to Broome from Crux. In a worst case scenario, where full holding fuel is required and a head wind is present, approximately eight passengers could be transferred. Consequently, Broome cannot be considered a reliable alternate for Crux.

CAPE LEVEQUE/LOMBADINA

Cape Leveque is located 227 nm and approximately 114 minutes flying time south-southwest of Crux. In a best case scenario, where no additional holding fuel is required and there is no headwind, approximately 16 passengers could be transferred to Cape Leveque from Crux. In a worst case scenario, where full holding fuel is required and a head wind is present, approximately 11–12 passengers could be transferred.

The runway is expected to be bitumen-sealed in December 2007, and will allow for the landing of a fixed wing that can carry up to 12 passengers. Passengers can be taken from Cape Leveque by fixed wing, helicopter after refueling, or by road transport. The road between Cape Leveque and Broome is gravel surface in part and may be unavailable in the wet season. The journey by road takes approximately three hours. A further option is to transfer passengers by helicopter or road to the nearby Lombadina airstrip. Lombadina is located 7 nm or four minutes flying time to the south of Cape Leveque. The airstrip has been developed for the Royal Flying Doctors Service emergency evacuation of the communities in the area. The airstrip is owned and operated by the Aboriginal traditional owners. Inpex have a commercial arrangement to use the airstrip.

Hard stand parking area is also being upgraded for up to three helicopters. The accommodation is being upgraded to allow pilots to stay overnight if required, so that multiple flights can be made to the rig if necessary. The approved GPS instrument approach for Cape Leveque was included in the November 2007 Instrument Approach and Landing charts (IAL) amendment. This instrument approach procedure allows flight crew to operate into Cape Leveque in most weather conditions provided the crew ise trained in GPS approach operations and the aircraft is equipped with suitable GPS units. To enable Cape Leveque to be utilised as an alternate airport in all weather conditions, the helicopters and crew need to have navigational capabilities that are compliant with CASA Technical Standards Order (TSO)-C145a or TSO-146a. TSO-C145a is a standard for airborne GPS sensors providing data to a flight management system, while TSO-C146a is for stand-alone GPS receivers. The main commercial helicopter providers to the petroleum industry in Australia have indicated that the TSO upgrades noted above will not be available in Australian aircraft for the

2007/08 cyclone season. They expect to progressively upgrade the fleet over the next few years. This will result in Cape Leveque becoming a much more reliable option in all weather states.

Terminal Aerodrome Forecasts (TAFs) can be made available for Cape Leveque upon request to the BOM. Currently there is no AWIS at Cape Leveque, although there are indications that an AWIS will be installed next year at Lombadina. This will improve the reliability of the weather forecasting at Cape Leveque.

KUPANG, WEST TIMOR

The location of Kupang to the north of Crux provides for a reliable evacuation option for cyclones approaching from the east and northeast. Kupang airport (El Tari) is 180 nm north-northwest of Crux, and approximately 90 minutes flying time. It is the closest alternate, after Truscott and Troughton Island. In a best case scenario with no fuel holding and no headwind, the full passenger load of 18 people could be transported from Crux to Kupang. In a worst case scenario with one hour holding fuel and a headwind, approximately 13 passengers could be transported. Due to the shorter relative distances, it is likely that the helicopter and pilot hours would allow for two return trips in a day if necessary.

Due to the apparent advantages offered by a reliable alternate to the north of Crux within a reasonable flying distance, Nexus undertook a ground-truthing assessment of Kupang in order to investigate its suitability. Kupang is an international airport in Indonesia with related support services. Regular large airliners, such as a Boeing 737 aircraft, use this airport. The airport layout consists of a single 2,500 m long runway, with associated taxiways. There is a large tarmac hard standing to the north of the runway, and all surfaces are sealed and suitable for Super Puma helicopter operations. Hard stand parking is available.

Kupang has instrument approaches. The runway has electric lighting complete with backup generator power in the event of a failure of the main power supply, which will come on eight seconds after a failure. Runway 25 also has approach lighting. To the south of the runway 07 threshold is a military base with covered parking. This area is a suitable under-cover aircraft maintenance area. Jet A1 fuel is available from Pertimina Fuels via two fuel trucks. The quality of the fuel at KPG is considered acceptable due to the airport being used by large airliners maintaining a constant turnover of fuel.

Navigation aids on the airfield include a Very High Frequency Omni Directional Radio Range (VOR) and a Non Directional Beacon (NDB), with their associated instrument approach procedures or cloud break procedures. There is also a published GPS instrument approach procedure. There is a dedicated meteorology and flight briefing department which has the required facilities to source either the Indonesian or Jeppesen meteorology forecasts.

The terminal building is of an acceptable standard with clean facilities and a high level of security. The assessment party flew in on a commercial flight with Air North and out on a Pearl Air charter. The physical processing through the various administrative requirements was appropriate and timely. Marshalling and parking as well as baggage handling would be provided by the ground handling agent. Bus transfers to the hotel would be organised by the local agent.

There is a suitable hotel located in Kupang, about 15 minutes drive from the airport. It has suitable facilities, including an automatic cash dispenser and 51 airconditioned rooms. The hotel standard is suitable for the pilot crew rest requirements.

Overall, the level of professionalism demonstrated by the airport agencies and the quality of infrastructure was excellent.

INDUSTRY-WIDE COORDINATION

In August 2007 the rig manager of Songa Drilling presented a paper at the Industry Drillsafe forum regarding the failed down-manning cyclone evacuation incident. There was significant interest generated by petroleum companies as a result of this presentation, which in turn has encouraged closer liaison between operators in the Timor Sea region on cyclone evacuation issues. Nexus

approached the petroleum industry body, APPEA, to set up and coordinate an industry working group for improvement of cyclone evacuation in the Timor Sea. The first meeting of the group was convened on 24 October 2007, and included representation from most of the companies operating in the Timor Sea, as well as the main aviation providers and the operator of Truscott air base.

The objectives and scope of the working group are to:

- share information to help improve cyclone evacuation management in the industry;
- identify and implement specific areas where a coordinated industry approach will lead to greater gains and outcomes; and,
- make improvements to the infrastructure and arrangements in the region required to support cyclone evacuation (e.g. air strips, fuel supply, and weather measurement stations).

The discussion at the meeting highlighted that the majority of the operators working in the region face the same challenges in respect to effectively implementing evacuations in a cyclone prone area. Furthermore, it was apparent that the significant level of petroleum industry activity planned for the 2007/08 cyclone season and beyond, was likely to have a cumulative effect of putting stress on infrastructure and resources, such as pilot hours, available aircraft, and fuel supplies. In addition there would be a significant number of personnel (indications were up to 700) requiring evacuation via Truscott or other airbases in the area over the same period. Therefore, it is imperative that the industry continues to work together to improve arrangements, infrastructure and coordination in the region.

CONCLUSIONS

Nexus undertook an extensive review of regional alternate landing sites relevant to Truscott and Crux. It was determined that landing alternates ideally need to be in close enough proximity to transfer full, or near full, passenger loads of around 18 passengers (when utilising a Super Puma helicopter). The most viable and reliable options for the Crux location were assessed as Cape Leveque and Kupang, West Timor.

Along with other technical solutions, Nexus has funded the upgrade of the existing Truscott BOM weather station facilities to AWIS. The improved weather measurement information has allowed for a 100 ft reduction in approach and alternate minima for the airbase. This is of potentially significant benefit given that the incident described in this paper was directly related to the inability of the helicopter to take off from Truscott due to restrictions on alternate minima.

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ACKNOWLEDGEMENTS

The authors would like to thank Songa Drilling for their assistance and cooperation during the initial incident investigations. Nexus would also like to thank the many organisations that contributed to the knowledge base and development of positive outcomes that are summarised in this paper, including: Bristows Helicopters, APPEA, Pearl Aviation, Shore Air, Shell, Hart Aviation, AGR, Interlink, Woodside, Inpex, ENI, and Coogee Resources.

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