CMDR RUSH: Sir, CAPT McLaughlin will take the first two witnesses this morning, who are Navy serving officers, and they will be followed, I anticipate, sir, by Mr Samuels and Mr Karlov, who will be the witnesses for today.

CAPT McLAUGHLIN: Commissioner, today we will hear evidence from two experts. This evidence will relate to the weather pertaining at the time of the initial Sydney/Kormoran signalling interaction, and it will also address the effects of such weather conditions and the effects they would have likely had on the tactical appreciation by both ships of the situation they encountered.

We will first hear from LEUT Scott Rivett, who is a Royal Australian Navy seaman officer and meteorologist. LEUT Rivett has examined a range of weather-related materials submitted to the Commission of Inquiry. In particular, LEUT Rivett will provide evidence as to sea state and direction, wind speed and direction, the bearing of the sun and the time of sunset, and the impending phase of the moon for 19 November 1941.

Following this, we will hear from CAPT Warren Bairstow, who is currently Commander, Surface Task Group at Fleet Command. CAPT Bairstow is a very experienced seaman officer and gunnery specialist. He has commanded both patrol boat and a WA-based major fleet unit. He has experience, including command experience, of the effects of weather on tactical decision making off the coast of Western Australia.

In particular, CAPT Bairstow will provide comment as to the effects of the weather on initial positioning, reading signal flags, launching sea boats and the tactical appreciation of remaining daylight. CAPT Bairstow will not comment on the actual engagement, as that is not the purpose of today's examination.

Sir, with your permission, I call LEUT Rivett.

<SCOTT JAMES RIVETT, sworn: [10.03am]

<EXAMINATION BY CAPT McLAUGHLIN:

CAPT McLAUGHLIN: Q. LEUT Rivett, when did you join the Royal Australian Navy?

A. In January 1996, sir.

Q. Through what training establishment did you join?
A. I joined at the Australian Defence Force Academy.

Q. How long did you spend at ADFA?
A. Three years, completing a Bachelor of Science degree.

Q. What were your areas of specialisation in your science degree?
A. I majored in chemistry and politics and sub-majored in mathematics.

Q. After the Defence Academy, when you graduated, what was the next step in your training continuum?
A. I proceeded through the junior warfare application course to HMAS Watson and various establishments around Australia to train up through all four phases of the seaman officer basic training, culminating in a Bridge Watch-Keeping Certificate.

Q. How long is this training continuum, culminating in the award of a Bridge Watch-Keeping Certificate?
A. It's one year to complete all the different phases - learning about relative velocity, ship identification, basic seamanship - and then anywhere between 6 months and 18 months to be awarded a Bridge Watch-Keeping Certificate, depending on which ship you were sent to and how much sea time you got.

Q. What are the major components? You have mentioned a couple already. What are the major components of this training?
A. All manner of identifying vessels, so you have to learn to read flags, learn rudimentary reading of signal lamps, ship handling, learn how to conduct boarding operations. In ship handling, the key things are keeping the ship safe and running activities within the ship, so you are organising your people and your time.

Q. On completion of your training, when you achieve the Bridge Watch-Keeping Certificate, what are you qualified to do?
A. You are qualified to represent the Captain on the bridge and keep the ship safe by day or by night, in company or not in company, also known as single ship steaming, so you are responsible for the ship's safety.

Q. After qualifying, where did you then serve?
A. I served in HMAS Townsville, a Cairns-based patrol boat, completed some work there and got my ticket. I then joined HMAS Canberra, which was a Western Australian based frigate, and served there for approximately nine months, doing various exercises and training. I was awarded my major fleet unit ticket on 11 September 2001.

Q. By "ticket", you mean?
A. A bridge watch-keeping certificate, sir, which is your entitlement to stand watch and represent the Captain. I then joined HMAS Newcastle, which was a Sydney-based frigate, and went to the Middle East for seven months doing work in the Gulf. When I completed that, I came back to do my navigation course for minor war vessel navigation and again posted to Cairns, this time joining HMAS Townsville, and spent close to a year doing patrol boat operations out of there before going to Iraq for another seven months, training up the new Iraqi Navy and the Coalition Military Assistance Training Team.

Q. When you did your minor war vessel navigation training, is this a step further than the basic navigation training that a seaman officer does?
A. It is, sir. As Navigator, you have a higher level of responsibility for maintenance of the chart outfit and to the Captain, and you are a more responsible member of the command team, and you also have a responsibility for training the junior warfare officers.

Q. Once you became qualified as a minor war vessel Navigator, you went on to serve in HMAS Townsville?
A. That's correct, sir.

Q. What operations did you conduct whilst you were a Navigator of patrol boats?
A. We conducted several patrols, ranging from Cairns to Broome, of the Australian Economic Exclusion Zone, for boarding operations, conducting boarding, doing basic patrol work, being involved in suspected illegal entry vessel apprehension, as well as the normal training, in company training as well, to improve the skill level of the junior warfare officers.

Q. As the Navigator on board a patrol boat, what is your role? What is your primary purpose?

A. The primary purpose is as a senior watch-keeper. The Executive Officer in a patrol boat is the senior watch-keeper, but the navigation officer spends a lot more time on the bridge, generally. Their primary purpose is to be on the bridge, to run the bridge team, to keep the chart outfit correct and to assist in the training of the junior warfare officers.

Q. What sorts of things do you, as a Navigator, do to assist in the training of the junior warfare officers?
A. I think the key is to develop the appreciation of the manoeuvring of ships at sea, and that includes visual signalling but also recognition of when a ship is altering - learning what is going to happen if you change course in comparison to the relative movement of another ship. It is called developing a seaman's eye and it is all about appreciating the distances between ships at sea. When there are no other indications of how far something is, you just learn - if the horizon sits at this point relative to the guns on a patrol boat, it means it is at this range, so you are really learning your environment around you.

Q. Once you completed your time as Navigator of a Fremantle class patrol boat, you said that you went to Iraq a second time?
A. That's correct.

Q. What was your function or your role during that deployment?
A. I was one of five lieutenants, Coalition. There were two Australians, and our role was to train up the new Iraqi Navy both in theory, so in the classroom, and Relvel and rules of the road.

Q. What is "Relvel"?
A. Relative velocity. As I mentioned before, one of the fundamentals of being a seaman officer is to have a good appreciation of the relative movement of ships at sea. Additionally, we taught the Iraqis boarding operations, towing operations and how to manoeuvre with small ships.

Q. Did you complete any sea time in Iraqi vessels during this period?
A. We did, sir. We outfitted the boats. We sea trialled them before we transited them from Jebal Ali Port to Iraq. Then we spent another five months training the Iraqis both

in the classroom and at sea. Probably every second day, we would be at sea for the entire day. Unfortunately, our rules of engagement meant that we couldn't go on live operations, but all the training and theory was exactly as we would have taught anyone.

Q. Where did you post on your return from Iraq?
A. I posted to the Bridge Training Faculty at HMAS Watson and I was the Junior Warfare Application Course Phase 4 Training Officer, which meant that I organised the courses for the trainees to go on before they went out to ships at sea. We would do daytime watches and night-time watches in a bridge simulator and we would change the weather conditions and change the number of contacts to try to develop these trainees' appreciation of how the ship was going to handle and things that they had to think about in relation to rules of the road and keeping the ship safe.

Q. This is all part of developing what you referred to as a seaman's eye?
A. Developing the seaman's eye, being aware of the ship's routines and how to keep the ship safe.

Q. After your time at the Bridge Training Faculty, did you go on to any further training or specialisations?
A. Yes, sir. After two years at the training faculty, I then specialised as a meteorologist through the Bureau of Meteorology, which is the only course you can do in Australia to make you legally entitled to give a forecast. That is conducted, as I said, through the Bureau of Meteorology in Melbourne and it's a postgraduate course.

Q. How long is that course?
A. It is 11 months long. The Navy conducts nine and a half months, which is the full requirement, and then whilst our civilian counterparts are learning about bushfire forecasts and things like that, we do a sea phase to align ourselves with the military requirements of finding your environment.

Q. What is the qualification you achieved at the end of that period of training?
A. A Postgraduate Diploma in Meteorology.

Q. Is the Navy meteorology qualification the same as or different from that gained from the Bureau of Meteorology?
A. It is an identical qualification, sir, and a lot of

Navy meteorologists move on, after a career in the Navy, to serve with the Bureau of Meteorology.

Q. On completion of this, where did you post and what sorts of duties did you undertake?
A. I then posted to Headquarters Joint Operations, where we continued to provide what used to be known as fleet weather oceanography forecasts but are now Joint Operations, because we also provide weather impact information to troops in Timor and personnel in Afghanistan as well.

Q. What is your current posting?
A. I'm still with the Joint Headquarters Operations, and that's now located in Bungendore in the new Joint Headquarters.

Q. Your role there remains doing forecasting?
A. Correct, sir. I continue doing forecasts.

Q. I want now to move to the issue of weather conditions off the WA coast in November 1941. First, were you asked to prepare a statement for the Commission of Inquiry?
A. Yes, I was, sir. I have typed up a written submission.

Q. Is this a copy of that statement? (Shown) Would you confirm that it is a true and correct copy of your statement?
A. Yes, sir. That's my signature. That's my statement.

CAPT McLAUGHLIN: Sir, I tender that statement.

EXHIBIT #109 STATEMENT OF LEUT SCOTT JAMES RIVETT

CAPT McLAUGHLIN: Q. First, I want to look at the sources you used in preparing the statement. What documents did you examine in relation to preparing the statement?
A. Sir, I was able to access whatever I wanted from the archives. The key things I wanted to look at were the routing charts and anything pertaining to charts or recordings of weather on the day, but the most useful was a 2008 report by --

Q. By Len van Burgel?
A. Yes. It is a good one, because he also refers to two

1991 studies done on the weather of the day. So that was the key document.

CAPT McLAUGHLIN: Sir, we would like to tender the paper by Len van Burgel and the preliminary studies done by Courtney, Southern, Steedman and McCormack, which van Burgel used.

EXHIBIT #110 STUDY ENTITLED "AN ANALYSIS OF WEATHER CONDITIONS OFF THE COAST OF SHARK BAY IN NOVEMBER 1941" BY JL VAN BURGEL

EXHIBIT #111 DOCUMENT ENTITLED "REPORT ON THE METEOROLOGICAL CONDITIONS NEAR 26S 111E FOR 17-28 NOVEMBER 1941" BY MR JOE COURTNEY OF THE BUREAU OF METEOROLOGY

EXHIBIT #112 DOCUMENT ENTITLED "CLIMATOLOGY OF WEATHER CONDITIONS W.A. WEST COAST NOVEMBER 1941" BY MR BOB SOUTHERN

CAPT McLAUGHLIN: We would also like to tender the final of those papers, which is a paper by Steedman and McCormack.

EXHIBIT #113 PAPER ENTITLED "BACKTRACKING THE LIFEBOATS AND FLOATS - A METOCEAN VIEW" BY MESSRS STEEDMAN AND McCORMACK

CAPT McLAUGHLIN: Q. What does the van Burgel paper go to?
A. Sir, the key elements are that it reviews the 1991 studies and compares them for suitability and accuracy and it highlights the methods used, the key method being in one of the studies attempting to extend a mean sea level pressure field and extrapolate that from observations along the Western Australian coast, and the other being a pattern matching method. The pattern matching method has become a lot more accurate, because we can now correlate that with satellite data of known wind fields that match corresponding conditions that were recorded on the day.

Q. You have mentioned two methods that van Burgel has used here - a mean sea level pressure analysis and the pattern matching. Could you please briefly describe or explain each of those methods and what they aim to achieve or what the outcome of applying those methods is?
A. Yes, sir. In the past, and certainly continuing today, depending on the size of the town, post offices or

pubs every day would record the temperature, the pressure and the wind. If you know certain characteristics of a body of air, being its temperature, humidity and the pressure, and you also know at what height that observation was taken, called a station level height, you can use a hydrostatic approximation and convert that to a mean sea level pressure. You could convert it to what the pressure would be at a kilometre. It wouldn't matter. It is following the equation.

Once you have all these points converted to a mean sea level pressure, you can then try to match these points, kind of like joining dot to dot, to a corresponding chart. So if we know 10 different points that all have different values, we try to find a chart of a mean sea level pressure analysis that has been done in the last 40 years and say do we have another chart that corresponds to these same pressures? If we can find one, we can be very certain, on a synoptic scale, which is a large scale, that this is what we would have expected to have seen on the day.

The scale of this also comes into point, because the smaller scale and more localised you become, the more variance there is and less certainty. You can have the lee effect of a mountain or friction or additional heating that you may not have been able to take into account, but as soon as you take it to a large scale, these little flaws and errors smooth themselves out and you are going to get a very accurate picture, certainly to within a few degrees and a few knots, as to what the wind conditions would have been at a given time.

Q. What were van Burgel's next steps in using this MSLP analysis? What did he then do with that?
A. He then basically did a computer search of the entire Bureau of Meteorology archives and their archive called ADAM. That records conditions across Australia for all the records that we have. He compared those, using computers to do the fast calculations, with the conditions known on the day and identified what he believed to be the mean wind conditions.

He backed this up using what are called the Navier-Stokes equations, which are equations governing the motion of compressible fluids. It is a couple of hundred years old basic theory, but he then said, okay, how do we apply this to our current problem, and they worked out that

it was effectively a south-south-easterly wind. The fact that it is a southerly wind generally takes out some of the room for error, because you are looking only at a north-south component; you are not looking at an east-west component. So even if you have a pool of errors, they are elongated in north-south. There is less variance. So that actually made his work a lot easier.

Q. So is this use of the MSLP and the following analysis of the MSLP an accepted and relevant methodological approach to the problem at hand?
A. Definitely. All the way through our seaman officer training, we get taught to look at a mean sea level pressure chart and, from that, infer the wind. It's called the geostrophic wind. That just means the wind in balance between the pressure and the movement of the earth. Most seaman officers, and certainly once they are qualified, would be able to look at a mean sea level pressure chart and identify what wind to expect. This is useful, because you can then plan ahead. So, yes, it is a valid method and the additional work that he did in correlating that with satellite derived winds, I guess, tied it in to what they expect the conditions were on that day.

Q. So, in your view, was this methodology applied appropriately in van Burgel's study?
A. It was appropriate, sir.

Q. What results did this analysis yield?
A. It was a south to south-easterly wind, 15 to 25 knots. My assessment, from mean sea level pressures and also from synoptic conditions, by which I mean the expected conditions on the day, would have been a south to south-easterly wind at 17 to 22 knots. That is how I would have forecast it.

Q. I would like to move now to a general overview of weather conditions, and then we will come down into specific elements of the weather conditions. What was the general weather picture which applied in November off the coast of WA?
A. Sir, we have what is known as the East Indian Ocean anti-cyclone, which is just a high pressure system, and we have a semipermanent coastal or inland trough, which starts at the Kimberleys, moves down to the Pilbara and then extends all the way down sometimes to Albany. That's a persistent feature of the Australian climatology. These

two weather patterns interact to have a generally southerly flow. That's the first component. That's the picture. We have the Western Australian coast --

THE PRESIDENT: Q. Is that throughout the year?
A. The East Indian Ocean anti-cyclone is a round-the-year event; the trough not so much. That is generated by extreme heating. It is a heat-induced trough. But the East Indian Ocean anti-cyclone is a permanent feature, sir.

CAPT McLAUGHLIN: Q. I want to move now to the more specific weather conditions for 19 November 1941 and specifically in the afternoon of that day. You have mentioned wind, so let's begin with wind. Where was the wind from? Actually, could we put the template on the screen? I may get you to illustrate on the template and draw in the weather conditions as we go.
A. The wind was from the south to south east, which is anywhere between 150 and 170 true bearing.

Q. That is where the wind is travelling from?
A. Yes. The arrow is pointing in the direction towards which the wind is going. I have done this because if you were holding up your shirt - or your hair - it would be blowing in that direction.

Q. At what speed was the wind travelling?
A. As I stated, 17 to 22 knots is what I would have forecast, but the study found between 15 and 25 knots. I would say that 20 knots is a fair assessment.

Q. There is some evidence before the Commission of Inquiry from Kormoran sources that the wind in the early afternoon was south south-east 3 to 4. What does this mean?
A. The "3 to 4" would have referred to the force. You have a Beaufort's force system, which describes the wind in terms of its effect on the sea.

CAPT McLAUGHLIN: We will call up a Beaufort's table, RAN.002.0139.

THE PRESIDENT: Could we capture that image? If we can, I shall mark it as exhibit 114.

CAPT McLAUGHLIN: Q. Could we go to the third page of that document. It is at page 0141. If we scroll down just

a little, this is the Beaufort wind scale that is used by the RAN and most Navies and most mariners to describe the wind. We were talking of a south-south-east 3 to 4. So could you explain what the "3 to 4" means?
A. The "3 to 4" there refers to a gentle, firstly, or then a moderate breeze, and that's at the lowest scale of what I would have assessed the wind to have been for the day.

Q. What is the upper limit of the wind at scale 4?
A. At scale 4, the upper limit, and just of note generally, is about 15 knots, where you start to see any white horses. The sea criterion is fairly frequent white horses. So at the upper limit, you start getting white horses or capping of your sea waves.

Q. Could we now return to the template. So far, we have a wind from 160 at speed --
A. The upper limit of force 4 was 16 knots in that previous document, and the findings of van Burgel were 15 to 25. I believe it was 17 to 22.

THE PRESIDENT: Q. In CAPT Detmers' book, he wrote that as the sunset and evening descended, the wind scale increased from 5 to 6. I take it that he would have been speaking, again, of the wind scale of Beaufort?
A. In the force, sir, yes. That would have been based on the appearance of the sea.

Q. And 6 has a velocity of 22 to 27?
A. Yes, sir.

CAPT McLAUGHLIN: Q. We will now move on to the sea and swell. First of all, could you explain the difference between sea and swell in weather terms?
A. The sea is the effect of the wind on the water where you are, whereas the swell is the effect of the wind on the water surface somewhere else and the energy wave then travelling to your position. So it is possible to have a swell from one direction and a sea from a completely different direction.

Q. On this day, where was the sea coming from?
A. The sea was from the direction of the wind, as I just said, so that's a south to south-easterly sea. A sea state of between 17 and 22 knots, which is what I have stated it to be, would have been sea state 4, which is 1.25 to

2.5 metres.

Q. That 1.25 to 2.5 metres is a height in the sea state. Where is that measured from?
A. You measure it from the base of the trough of the wave to the peak.

Q. Could you mark the sea and the swell for us on your diagram?
A. The sea is from the same direction as the wind, and the swell is as a result of the East Indian Ocean anti-cyclone, which is a generally southerly swell up the coast, so I will put that.

Q. So the swell also is coming from a southerly direction; is that right?
A. Affirmative.

Q. What was the height of the swell?
A. A moderate swell is the climatology. I have read no reports of any cyclones or anything that would have changed any of this, but it is about a 2 metre swell. There is a moderate swell expected for that time of year.

Q. There is some evidence before the COI from Kormoran sources that in the early afternoon, conditions included sea state 3, medium swell from south-west. Does this accord with your view?
A. Yes, I would be happy to accept a south-westerly report. I would have said southerly as my first guess. If someone said, "Where do you expect the swell to come from?", in that part of the world I would say the south.

THE PRESIDENT: Q. One relevance of this material is that if Sydney, after the engagement, was in a sea state described as 4, then, according to the DSTO information, her prospect of surviving was nil, because of the damage suffered?
A. Yes, sir. If you have a 2 metre swell and then on top of that you have up to a 2.5 metre wave, from peak to trough you can sometimes have 4.5 metres. I don't know what the draught of the Sydney was, but any damage near the waterline could sometimes have up to 4 metres of water pressure.

CAPT McLAUGHLIN: Q. I want to move on to visibility - firstly, visibility range. What was the visibility range

in these weather conditions?
A. I would say 10 to 15 nautical miles, which is out to about 30 kilometres. At that range, that's when you can start identifying finer features and details. It is not to say you couldn't see a mountain at 50 kilometres, but that's a large object. To identify a mast against the horizon or anything similar - 10 to 15 nautical miles.

Q. There is some evidence before the COI from Kormoran sources that Kormoran sighted Sydney's mastheads at 33 kilometres, which is approximately 18 to 19 nautical miles. Would this accord with your view of the visibility on the day?
A. Yes, that's extremely likely. As I said, 10 to 15 would be my standard expectation, and adding to that because it is on the eastern side of a high pressure system where the conditions are favourable for good visibility.

Q. Does the fact that the Kormoran lookout was located above sea level in a higher part of the ship add to or detract from his ability to detect something at a further distance?
A. The higher you are, the further you are away from any effects of the wind-blown spray, so you get better visibility if you are above that.

Q. How much cloud cover was there on the day?
A. Again, based on the fact that it was on the leading edge or the eastern edge of a high pressure system, I would say one to two octres, or eighths, of the sky would have been covered with cloud, but because it is a high pressure system, you have a strong inversion, which prevents development of cumulus-type clouds, so there wouldn't have been any rain or anything about.

THE PRESIDENT: Q. LEUT Bunjes described the weather as "very clear".
A. I would agree with that, sir.

Q. According to him, the vessel, when sighted, was about 20 to 25 miles distant?
A. That's completely plausible, sir. Most of our recommendations and our forecasts are for someone standing on the bridge of the ship, so if someone is higher up by another 5 or 10 metres, they will have an extended range.

Q. He was in the crows nest, I think.

A. He would have had an even better range.

CAPT McLAUGHLIN: Q. I now want to move on to the impact of the sun and the moon on 19 November 1941. What time was sunset on 19 November 1941?
A. It was at 19:05, based on the latitude and longitude where the Sydney was found. That time could change by 1 or 2 minutes, depending if they were further north, south, east or west.

Q. How quickly would it have become dark after sunset?
A. You have what we call civil twilight, which is when the sun is 6 degrees beneath the horizon. At that stage, you could still probably read a novel or something, but you would certainly know it is getting dark. That occurs for about 20 to 25 minutes, again depending on the latitude or longitude, but at these latitudes it is not a significant difference. I only make reference to that because if you are close to the South Pole, you are going to have permanent twilight. But for these latitudes, it is about 25 to 30 minutes.

The next phase is when the sun is 12 degrees beneath the horizon. That's known as nautical twilight. We in the Navy use that as a good time to take our star observations, because you can still see the horizon, but it is getting difficult to read anything. You would certainly struggle to write down your observations. That's about another 20 minutes later. We're now looking at 19:40, 19:50. Then by 20:00, it would have been total darkness, and it was also a new moon, so only 1 per cent illumination.

Q. We will come to the moon in a moment. There is some evidence from a Kormoran source that they calculated that darkness would be at 19:00 hours. Does that approximately accord with your view?
A. Yes. You have 15 minutes per degree of longitude, so your sunset is going to change depending on what longitude you are. The time that you are experiencing relative to the sun versus the time you have set for your time zone is what that difference is.

Q. What was the bearing of the sun for sunset on this afternoon?
A. 248 was the azimuth.

Q. There is some evidence before the COI from Kormoran

sources that Kormoran, at around 16:30, turned into the sun full speed towards the sun 250 degrees. How does this accord with your view?
A. Yes, the sun - over a few hours leading up to sunset, the bearing of it is going to change only to within 10 or 15 degrees maximum. So anywhere between 260 and 245 would have been generally in the direction of the sun.

Q. That would have been including at about 16:00, 16:30 on that day, 19 November 1941?
A. Yes, so a little bit further north, obviously, for a few hours before.

Q. But within a 10 to 15 degree spread?
A. A 10 to 15 degree arc.

Q. What was the phase of the moon for 19 November 1941?
A. A new moon, sir.

Q. What does this mean - a new moon?
A. It means that, at night, there is no illumination. Obviously, the moon just reflects the light of the sun. In a full moon, obviously you can sometimes read by that, but for a new moon, it is only the stars that are going to provide any illumination. Total darkness is what that means.

Q. So no moonlight to aid visibility at night?
A. No, sir.

Q. There is some evidence from a Kormoran source that, "Nights in this region were light, so light that once visual contact with an alien vessel had been established, it would not be lost." With respect to the night of 19 November 1941, does this general statement accord with your views?
A. The nights are clear, but they are going to be illuminated only if you have a moon, if you have a light source.

Q. I now want to move on to some more specific effects of the conditions which we have discussed. The first is the weather relative to Kormoran. In particular, we will start with the wind. If I could ask you to assume for the purpose of this evidence, and draw on your template, that the Kormoran was steering a course of 260 and she was at a speed of 14 knots.

A. This is just a relative vector (indicating), obviously, because Kormoran, for the purposes of this, remains at the centre of the manoeuvring form.

Q. Where was the wind relative to Kormoran if she was steering a course of 260 at 14 knots?
A. At 14 knots? If there was zero wind, the wind that she would experience would be from right ahead, because she is driving into it. But the wind is at, I will say, 20 knots from 160. The way the Relvel works, we have to take that into account. So the combined vector is the relative velocity, which is circled, sir. I will bring that back to the centre of the ship. Someone standing on the Kormoran at that course and speed, with a 20 knot 160 wind, would experience a wind where I'm drawing this arrow, from this direction, the implication being that any flag hoist she is flying will be flying downwind. So that is the relative position of the wind relative to Kormoran.

THE PRESIDENT: Q. Could you do the same exercise with some dotted lines for 240 degrees?
A. For the course, yes, sir. And at 14 knots, sir?

Q. Yes. That makes a slight difference?
A. It makes a little bit of difference.

Q. Not a great difference?
A. Not a great difference. In fact, at 20 knots, so you can see that between zero and 20 knots, that's the relative position that the flags would have been flying for a course of 260.

THE PRESIDENT: Thank you.

CAPT McLAUGHLIN: Q. You have conducted a relative wind calculation. Is this a commonplace calculation or is this something that just Mets do?
A. No, all seaman officers do it. When you are on the bridge, you use the same relative velocity principles for working out how to close another ship or how to approach another ship within 500 yards on a particular bearing. It is called station-keeping. This is certainly commonplace and I would expect that every officer of the watch would be doing wind calculations at least every hour.

Q. Taking this relative wind, I want you to assume that Sydney is 10 degrees off being right astern of Kormoran, so

at a relative of green 170 on Kormoran's ship's head. Let's use 260 as her course.
A. Okay, so right ahead is there, right astern is there, and 10 degrees from right astern is where I have indicated the Sydney.

Q. Would you highlight again the vector that would be where the flags were pointing or flying if Kormoran was at 260 at 14 knots for Sydney?
A. That vector (indicating).

Q. So how much of the flags would Sydney have been able to see in that position?
A. On the assumption that the flags were in a fully visible area, anyway, Sydney is looking towards the ship, so they would see maybe 60 per cent of the flags, but keeping in note the sun at this point.

THE PRESIDENT: Q. 248?
A. That would be azimuth of sunset. It wouldn't have reached that yet; it would still be in this area. So the flags, which are not transparent, would have been backlit by the sun, so they would be casting a shadow on themselves, making them also more difficult to read.

CAPT McLAUGHLIN: Q. Would the presence of superstructure or funnel or masts and the like aft of where the flag hoists were have any further effect on this?
A. Definitely to obscure, but also the funnels themselves would be emitting a lot of heat. You would have all seen - well, I have - the heat haze effect of the bonnet of your car. You can see the heat haze. For a ship that is manoeuvring at high speeds or certainly at maximum speed, the heat haze is significant and would also make it more difficult to read flags that were on a distant side.

Q. Another assumption, another assumed or postulated position, is that Sydney may have been on a starboard quarter, so green 135, on Kormoran. Where would that have been in relation to the vector in which the flags would have been flying?
A. Firstly, "green" means the starboard and "red" is the port. "135" is 135 degrees to starboard from Kormoran's ship's head, which would be in that area (indicating) which would almost be looking down the line of the flags.

THE PRESIDENT: Q. That area is where you have marked a

circle at about 135 degrees?
A. Affirmative, sir. That's position green 135.

CAPT McLAUGHLIN: Q. From that position, looking at the flags, you would have been looking at them --
A. Almost end-on. You would probably have seen 10 per cent of a poorly illuminated flag.

Q. You spoke a moment ago about the bearing of the sun relative to both Kormoran and Sydney in either the astern or 10 degrees off the astern position and around on Kormoran's starboard quarter. You mentioned the effect that the fact that they were looking into the sun would have on the flags. Would you explain that a little more?
A. The sun would be forcing the flags to cast somewhat of a shadow on themselves. They are not cellophane, they are made of cloth which is not transparent to the sun, or not significantly transparent. So the colours of the flags would have been looking less bright, basically.

Q. At what inclination or height above the horizon at 16:30 or 17:00 would the sun have been? Would it have been well above so that it wasn't casting back on the flags?
A. It would have been about 20 degrees above the horizon, sir. I haven't done the exact calculation for it, but it is easy to do.

Q. So reasonably low to the horizon?
A. Yes. 15 degrees is, generally, taking your arm out, so 20 degrees is one-and-a-half hand spans above the horizon, starting to really fall down.

CAPT McLAUGHLIN: Sir, that concludes my questioning of LEUT Rivett.

THE PRESIDENT: Thank you.

CAPT McLAUGHLIN: At this point, I will tender the completed diagram.

EXHIBIT #114 COMPLETED TEMPLATE WITH DIAGRAM AS DRAWN BY LEUT RIVETT

THE PRESIDENT: Q. What was the angle of approach at which you said 60 per cent of the flag would be visible?
A. That would be from green 170, sir.

CMDR RENWICK: Sir, I just have one question, if I may.

THE PRESIDENT: Yes, CMDR Renwick.

<EXAMINATION BY CMDR RENWICK:

CMDR RENWICK: Q. You have given evidence about where the sun would be in relation to the horizon about 16:30 or 17:00. What effect would the position of the sun at that time have on viewing a daylight flashing lamp coming from the Kormoran?
A. It would reduce your ability to easily see it, sir, because you are already looking generally towards the sun. If you are driving, you have sun glare issues with the sun a reasonable distance above the horizon so to then try to discern a flashing light, whether it is a 5-inch or 10-inch flashing lamp - you would see it, but it would impact on your ability to easily see it, sir.

Q. Finally, in relation to both of the positions you have postulated for the Sydney on that chart, what would be the effect on viewing the silhouette of the Kormoran from the Sydney?
A. The same issue with the shadowing, casting shadows upon itself, would apply. With the sun in that position, it would be harder to see the length of the ship accurately, for example, because you couldn't make out as many finer features on the ship to get a gauge for, "Oh, this ship is this long; there is its funnel". You would see the front, you would see the funnel, you would see the end - the stern - but all the finer details in between would become a lot more difficult to see until you were at closer range, by which I mean probably 2 nautical miles.

Q. There is just one other matter. Do you have your statement there?
A. No, I don't have it, I am sorry.

Q. I will read out paragraph 11. You there say:

> Additionally I assess that the maximum range at which an experienced officer or signalman could read flags in these conditions would be 10,000 yards (5nM) for a flag hoist that you were expecting to see, however it is more likely that with an unfamiliar flag hoist this would reduce

significantly.

Are you assuming, in making that statement in paragraph 11, that the signal flags of merchant ships in World War II were the same size as those of warships at that time?
A. Yes, I am, sir.

CMDR RENWICK: Thank you. I have no further questions, sir.

THE PRESIDENT: Q. If my recollection serves me right, there is some evidence from at least one of the German survivors that following a signal from Sydney they in fact drew the flag hoist halyard to starboard, or drew the flag to starboard, I'm not sure which.
A. Sir, to move the flags further to starboard?

Q. Yes?
A. Yes, that would be to let the flags fly better in the wind, I believe.

Q. Would it affect the angle at which the flag flew?
A. No, sir. The relative position of the wind wouldn't change unless the wind or the ship changed.

Q. But it may have improved visibility because of absence of other structures or whatever?
A. Yes, sir, it would have potentially freed those flags away from the superstructure to let them fly further, higher.

THE PRESIDENT: Is there anything arising out of that?

CMDR RENWICK: Just to note, sir, that the reference, I think, to which you were drawing attention is at page 453 of the Official War History, where it is stated:

> Ahlbach, Kormoran's yeoman of signals, drew the halliards to the starboard side to make the flags more visible ...

THE PRESIDENT: Thank you.

CAPT McLAUGHLIN: May LEUT Rivett be excused?

THE PRESIDENT: Yes, thank you, LEUT Rivett.