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論文
Article

台灣水域的潛艦作戰

Submarine Operations in Taiwan Waters

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戰略架構
The Strategic Framework

迅速地瀏覽過西太平洋一帶的地圖或海圖，吾人可立即得知台灣的戰略位置。

A quick look at the map or at a chart covering the western part of the Pacific immediately shows the observer the strategic position of Taiwan.

台灣位在熱帶區，有北回歸線行經，與中國大陸僅隔非常狹淺的台灣海峽。台灣海峽僅有八十至一百海里的寬度，由歐洲經新加坡到日本的重要海上交通線由台灣海峽經過。因此，對許多國家而言，台海及其不受干擾的海上運輸具有極為重要的戰略價值。就此觀點，台灣海峽具有國際性的利益。由於繫乎高度的利益，一旦台海發生衝突，將會立即引起許多本區或其他地區強大海上國家的關注。

瑞典皇家海軍上校布・魯斯克上校? 曾服務役於十三艘潛艦？擔任其中三艘的艦長?? 並曾於潛艦作戰司令? 潛艦戰隊參謀長與海軍東部司令部參謀長之下任職作戰參謀? 現為瑞典海軍潛艦第一戰隊指揮官？魯斯克上校也是瑞典皇家海軍科學協會會員? 本文純為作者個人見解？不代表瑞典政府？瑞典皇家海軍或其他組織之意見? 本文中文由陳文政？本刊執行編輯？翻譯？ Royal Swedish Navy Captain Bo Rask served on thirteen boats and commanded three of them. He worked in the Naval Staff as Director Submarine Warfare and Chief of Staff at the Submarine Flotilla and Chief of Staff Eastern Naval Command before his current appointment of the Commanding Officer of the Swedish First Submarine Flotilla. Captain Rask is a member of the Royal Swedish Society of Naval Sciences. The views contained in this article are the author's and do not represent any opinions of the Swedish Government, the Royal Swedish Navy, or other organizations. The Chinese text is translated by Mr. York W. Chen (Executive Editor of **Taiwan Defense Affairs**).

Taiwan is located in the zone of tropics almost on the Tropic of Cancer, separated from the Chinese mainland by the very narrow and shallow Taiwan Strait. The Strait is just some 80 - 100 nautical miles wide. The important sea line of communications between Europe - Singapore and Japan runs through the straits. The Strait and undisturbed shipping along that sea route therefore have a high strategic value for many countries. The Strait has in that respect a worldwide interest. A conflict in the Strait will immediately due to the high interests at stake, draw attention from several strong Maritime nations in the area and elsewhere.

台灣海峽對中華人民共和國而言，具有重要的作戰與戰術價值。中國在華東沿岸的軍事及民間海上運輸必須經由台灣海峽以連接其華南與華北。台灣正幾乎位於華東部沿海的中心點。從台灣至少可以短暫地威脅到中國沿岸的海運，而且能切斷中國的海上交通線。台灣可以輕易的扮演航空母艦般的角色，對中國構成嚴重的空中及海上的威脅。

The Strait also has an important operational and tactical value for the People's Republic of China (PRC) Chinese military and civilian coastal shipping along the eastern coast of China has to run through the Strait to connect the southern and northern parts of China. Taiwan is located almost on the middle of the eastern seaboard of China. From Taiwan, is it possible at least temporarily, to threaten the shipping along the coast of China, and thereby cut the PRC sea lines of communication. Taiwan could easily be a platform (similar to a carrier) from which a serious air and naval threat to the PRC can be established.

最後，由於台灣是高度依靠出口型經濟的國家，公海的自由通行以及進出台灣的航運安全將攸關其生存。

Finally, the free access to the high seas and a free navigation along the sea routes to and from Taiwan is essential to the national survival of Taiwan due to Taiwan's needs as an export-oriented economy.

因此，在許多方面，台海顯示出其為一全球性傳統海上熱點，此一熱點可輕易點燃一個巨大的火藥庫，並影響到區域的安定。對於那些國家生存或經濟發展繫乎海運的國家而言，在此一地區海軍的存在將甚為重要。從基於不同利益的許多國家而來的強大海軍，處在同一個海洋熱點上，可能是安定的因素，但也可能會增加區域的緊張。

The Taiwan Strait therefore in many respects represents a classical Maritime hot spot on the globe. That hot spot can easily be the spark in the powder-barrel that threatens the stability in the region. Naval presence in such an area is paramount for nations that rely on shipping along the sea lines both for its survival and for the increase in their economy. A strong naval presence from many countries with different interests at the same spot of ocean can be a stabilizing factor, but can also rapidly increase the tensions in the area.

表面上，中國有一支強大的海軍以及強大的潛艦兵力，但若細看其堪任作戰的序列，我們將發現中國有許多艦隻已經非常老舊並且無法適用於短淺水域的作戰任務。中國海軍的力量主要在於其有數量頗多的飛彈快艇以及紮實的兩棲登陸的能力。但如果中國決定干擾進出台灣的航行自由，其海軍力量亦可以藉由海軍封鎖加以達成。另外，入侵的可能性也必須考量。中國的潛艦兵力有許多不同款式的潛艦，包括核子彈道飛彈潛艦、傳統彈道飛彈潛艦、核子攻擊潛艦、傳統導向飛彈潛艦、傳統潛艦等等，可扮演不同的任務，但並不必然都會用來對付台灣。許多艦隻是老舊的設計，作戰潛能較低。而核子彈道飛彈潛艦及核子攻擊潛艦需要較深的海水才能執行作戰，台灣海峽並不具備這樣的條件。

On the paper, the PRC maintains a strong navy and a strong submarine force. A look at the order of battle tells us that many of the ships are of older origin and not especially suitable for operations in shallow water. The strength of the PRC navy lies mainly in the large number of missile attack boats and it's substantial amphibious capability. That naval force can also easily disturb the free navigation to and from Taiwan with a naval blockade if PRC decides to do so. The possibility of an invasion lies also at hand. The PRC submarine force consisting of a range of different boats; SSBN, SSB, SSN, SSG, SSK and SS all have their different roles to play, not necessarily against Taiwan in case of a conflict. Several boats are of an older design with a low battle potential. The SSBN and SSN needs deeper water than the Strait can provide.

在此重要的地區，小規模的潛艦兵力仍可以執行非常成功的作戰。從美國在第二次世界大戰對於日本的潛艦消耗戰中，可以看到許多美國潛艦成功攻擊日本在台灣海峽及華東海運的案例。有許多傳奇性的案例包括：美國布拉柏號艦（指揮官富魯奇）在一九四四年十二月到一九四五年二月的第十一次戰鬥巡邏，美國唐號艦（指揮官歐肯）在一九四四年六月到七月的第三次戰鬥巡邏以及美國唐號艦（指揮官歐肯）在一九四四年九月到十月的第十五次戰鬥巡邏。唐號艦在它最後一次作戰任務中，在東海的南方——特別是在台灣西北部與中國沿海間——一帶巡邏。因為東邊有水雷區，西邊是敵對軍所在的海岸，因此這次任務特別的危險。由於發射魚雷誤擊自己，這艘有名的唐號艦在這次巡邏中沈沒。

Submarine operations with small submarines in such an important area can be very successful. From the US submarine attrition war against Japan during WW II, there are numerous examples of successful submarine attacks against the Japanese shipping in the Taiwan Strait and along the eastern coast of China. Legendary is the eleventh war patrol of the USS Barb (Commander Fluckey) in December 1944 – February 1945, the third war patrol of the USS Tang (Commander O´Kane) June – July 1944 and the fifth war patrol of the USS Tang (Commander O´Kane) September – October 1944. On that last patrol the submarine operated in the southern reaches of the East China Sea; specially the reach between Northwest Taiwan and the China Coast. That area was dangerous due to minefields to the eastward and a hostile coast to the west. The famous USS Tang was lost on that patrol, due to a circular run on one of her own torpedoes.

美國的潛艦消耗戰成功地箝制了食物、原油、橡膠和其他重要工業原料的補給，對於日本最後的無條件投降有很大的貢獻。

The US submarine war of attrition successfully choked of the supply of food, crude oil, rubber and other vital industrial raw materials, thereby strongly contributing to Japans ultimate unconditional surrender.

就台灣而言，其主要防衛的戰略很顯然地是要不被中國消耗戰或此類的威脅所箝制。因此，台灣戰略很重要的一部份是必須建立起與其他重要海權國家強而有力的關係，這些國家能在台海緊張情勢升高時會救援台灣。在這些國家中，唯一具有真正海上實力並在鄰近地區（沖繩）有基勤設施以應付台海衝突的，就是美國。台灣防衛戰略另一重要的部分是，必須建立起一支空軍與海軍的武力其能夠在衝突發生時承受起中國的第一擊，並能因此增加中國在防衛計畫上的困難。一支強大的潛艦兵力是此兵力架構的基石。現代化潛艦可以把戰爭帶向中國整個脆弱的沿岸，這一點將對台灣非常有利。而且，以現代化潛艦作戰的難以預測，並且也難加以偵測並摧毀。是故，現代化潛艦能夠改變整個區域的戰略情勢，使其轉變為有利於台灣與其安全政策情勢。現代的潛艦必須位於台灣採購的優先名單中。

The main defence strategy for Taiwan obviously has to be to avoid being choked by a PRC threat of war of attrition or that such a war breaks loose. An important part of the strategy must therefore be to build strong relations to important naval powers that can come to assistance in case of an increased tension in the area. The only country with a true naval capacity and base facilities in the vicinity (Okinawa) for such a conflict, is the USA. Another important part of the strategy must be to build up an air and naval forces capability that can take the first blow in case of a conflict and that could increase the defence planning difficulties for PRC. A strong submarine force can be the cornerstone in such a force structure. Modern submarines can take the war to the enemy along the whole China coast, which is very valuable. They are unpredictable in their operations and extremely difficult to detect and destroy. Modern submarines can change the whole strategic situation in the East China region in favour for Taiwan and it's security Policy. Modern submarines must therefore stand in the front of the Taiwan shopping list.

作戰環境：對於潛艦作戰的意涵
Operational Conditions: Implications on SM Warfare

由一個潛艦人的角度來看台灣周遭的水域及海岸環境，需要體認到下列幾項特質：

When looking at the coast and the surrounding waters of Taiwan from a submariner's point of view, is it important to recognise the following features:

自一九四九年以後，台灣就是美國與中國兩大軍事強國間的熱點，就此一角度，台灣的戰略態勢和瑞典在冷戰時期的經驗相當類似。瑞典在北約與華沙組織之間，而蘇聯的船隻只要在幾個小時之內即可開抵瑞典。由於台灣相當接近中國，這使得

美國的兵力很難能夠持續地掌控台灣周遭的水域。因此，台灣必須有強大的軍力能夠在中國決定攻打台灣時，承受住中國的第一擊。過去與現在中國都不斷地增強其海軍實力，並藉由軍事演習展現其軍事實力及攻擊台灣的企圖，業已帶來區域的緊張。這樣作法已經引起美國決定增加在此一區域的海軍部署，其結果慢慢消減了緊張局勢。但是，從中國傳遞而來的訊息是相當清楚的：「我們有能力威脅並干擾你們的進出口海運！」如果沒有美國的軍事部署使之冷卻，中國這樣的威脅及軍事演習，將極可能把整個世界帶向第三次世界大戰的邊緣。因之，台灣的防衛戰略必須非常清楚，並具有遠見，並從中國的角度去設想。台灣將需要在每一個相對於中國的軍事層面上都呈現出堅實的態勢，不讓中國誤認為台灣是軟弱的，或台灣不會使用軍事武力，或會遲疑請求外來的軍事援助。

Taiwan has since 1949 been in the focal point between to strong military opponents USA and China. In this respect, the strategic situation of Taiwan is very similar to the one that Sweden faced during the cold war. Sweden was in between NATO and the Warsaw pact, with the Soviet Union just some hours-sailing time away. Taiwan's immediate proximity to China makes it difficult even for US forces to constantly control the waters surrounding Taiwan. Therefore Taiwan has to have military forces that strong, that they could take the first blow if PRC decides to attack Taiwan. Now and then, China has increased its naval presence and thereby the tension in the area, by conducting exercises in order to show naval strength and to threaten Taiwan. At some stages this have caused USA to increase its naval presence in the area – and as a result, the tension slowly decreases. But the message from PRC is crystal clear – we have the capabilities to threaten and disturb your import and export shipping! The threat and the PRC exercises can, if not calmed down by US naval presence, easily take the world to the brink of the third world war. The Taiwan strategy must therefore be clear, foresighted and from the PRC side predictable. A firm appearance from Taiwan in every military aspect concerning PRC is absolutely necessary. Otherwise PRC may think that Taiwan is soft and will not use its military forces and / or hesitate to call for military (naval) assistance.

對於台灣而言，中國的威脅是明確的。不難猜想這樣強大的軍事威脅如此地接近台灣，會讓台灣的防衛計畫者如何地頭疼。而缺乏適當與數量太少的海軍武力則會讓此一問題更加嚴重。更何況目前中國的商業市場現在正在蓬勃起飛，使得許多也許想要在此區域不穩定中幫助台灣的國家為之卻步，。

PRC is the well-identified threat to Taiwan. It is an easy guess that the great military potential so close to Taiwan, is causing the Taiwan military planners a severe headache. Lack of adequate and too few naval forces increase the problem further. The unstable situation in the China region is also causing a moral dilemma to many other countries that want's to help Taiwan, but is faced with the economic possibilities of the commercial exploitations on the enormous Chinese ma rket.

強大的中國海上艦隊及空中武力所擁有的武器具有相當的射程及準確度，可同時威脅到台灣海軍在台灣島兩側的兵力。我們必須估算中國部隊的雷達很可能可偵測到所有在台灣區域內的船隻與飛機。我們也必須假定在衝突發生後的幾個小時之

內，所有台灣的海軍基地都將暴露在敵人的空中攻擊之下。但是，中國的海軍艦隊並不能應付以聯合作戰模式而同時在他的東岸以不同的方向出現的海上威脅。

The strong Chinese Fleet and its airforce had both the range and precision in its weapons to threaten the Taiwan naval forces simultaneously on both sides of the Taiwan. We have to estimate that PRC units most likely have radar contact with all ships and aircraft's over the whole Taiwan region. We also must assume that all Taiwan naval bases could be exposed to enemy air attacks within the hour from the outbreak of a conflict. But the PRC Fleet can not handle a situation where it is faced with serious naval threat in Joint operations from many directions along the whole East Coast of China.

一支潛艦兵力能把戰場帶向敵境，並牽制住中國的海上的護衛兵力與掃雷兵力，更可在中國的空中攻擊之下達成隱匿。就此而言，一支潛艦兵力對台灣海軍是相當重要的，它也是對中國構成主要的威脅的來源。這樣的潛艦兵力不必需要很多的船，作者認為六到八艘現代化的潛艦就足以能大大增加中國的不確定性。而台灣潛艦兵力對中國沿岸海運所可能的攻擊，將對中國能否控制其鄰近重要水域構成相當大的威脅。當然，一旦中國入侵的艦隊跨過台灣海峽之際，台灣訓練有術的潛艦兵力也將會是特別有價值的資產。而且，在這樣的入侵發動之前，如果台灣的潛艦能夠蒐集足夠的情報以顯示出中國兵力正在其港口集結，也將具有非常高的戰略價值。中國若要確保這些海域的制海優勢，將需要有相當訓練及配備精良的海上兵力，能以協同作戰的模式進行大範圍作業。但台海以及華東海岸非常地有利於潛艦作戰，因此對中國而言，這樣的任務將很不容易。

A submarine force that can take the war to the enemy, tie up PRC naval escort and minesweeper resources and that could operate hidden from the Chinese air threat is therefore of key importance to the Taiwan Navy and of course a main threat to PRC. Such a submarine force doesn't have to include a lot of boats. I think that six to eight modern boats are enough to increase the PRC uncertainty. The possibilities of a Taiwan submarine war against the PRC coastal shipping are a serious threat to the PRC control of the nearest and most important waterways along the coast of China. Of course a Taiwan well-trained submarine Force also could be an especially valuable asset in case of a PRC invasion Fleet starts to navigate across the Strait. Before such an invasion starts good intelligence collected by Taiwan submarines of the PRC forces build up in the Chinese harbors is also of a high strategic value. The PRC desire to secure the control of these important waters will require well-trained and equipped naval forces that are able to work together in combined operations over a wide area. The Taiwan Strait as well as the East Coast of China are very favourable for submarine warfare, so the PRC task is not an easy one.

從潛艦人的角度看台灣海峽，其首要作戰要素是：只需要很短的時間就可抵達作戰區域。在出航後二到三天的時間內，台灣潛艦就可安全地抵達中國沿岸各地，以進行情報蒐集，並能對中國沿岸海運與其海軍兵力構成嚴重並持續的威脅。

The first operational factor to consider when looking at the Taiwan Strait from a submariner's point of view, are the short transit distances to the operation areas. Within

two to three days after sailing, a Taiwan submarine can safely be in its assigned area along the coast of China and from there collect important intelligence or establish a severe and long time submarine threat to the PRC possibilities to move its coastal shipping and naval forces.

由於台灣基地與中國大陸間的距離非常短，因此，台灣潛艦具有長期駐留於指定作戰區域的能力。相較於其他國家，它們海上兵力需耗時抵達作戰區域，自然地，如果要在短時間內抵達指定區域，將需要大幅增加速度。而其風險將會增加。在此區域，要找到能安全區域以呼吸管航行而不被船運、敵人巡邏或空中反遣機巡邏所偵測到也有困難。此一地理環境上的限制及距離上的狹短，意味著台灣海峽大部分的區域能被沿岸船艦及空中雷達系統有效的制海控制。越接近水面其被偵測到的風險也越高。對此問題，瑞典尋求科技來解決，其利用史塔林原理的絕氣推進系統，可使潛艦在指定區域內以低速在不用呼吸管換氣的情形下進行作業。瑞典現在是全世界唯一擁有現役非核子絕氣推進器的國家。

The short ranges between the Taiwan bases and the Chinese mainland, makes it also possible for the Taiwan submarines to operate in their assigned areas for considerably longer periods than for other Navies with longer transit to their operational areas. Naturally the demands on high transit speeds to reach the assigned areas in due time are also reduced. At the same time the risks increase. It is difficult to find safe snorkeling areas free from shipping, enemy patrol areas (search areas) and airborne ASW. The limited geographic areas and short distances mean that large parts of the Straits of Taiwan can be under constant naval control by coastal, ship and airborne radar systems. The risk of detection and danger close to the surface is therefore great. The Swedish solution to this problem has been to drive the technical development towards an operative AIP system based on the Stirling principles. Such a system allows the submarines to operate practically without snorting when on low speed in their assigned areas. Sweden is today the only country in the world with operative non-nuclear air-independent propulsion.

絕氣推進系統可提供需要滲透到敵人沿岸水域並且隱匿停留一段時間的潛艦艦長一些戰術上的彈性運用。我的建議是對於這樣重要的戰術問題台灣應該尋科技的解決方案。目前，史塔林式的引擎是解決此一問題非常有幫助的系統，而在未來，能提高能量輸出的燃料電池，將成為更好的解決方案。

The AIP system gives the CO the tactical flexibility he needs to penetrate in to the enemy's coastal waters and to stay hidden for an extended period of time. My suggestion is that Taiwan seeks a technical solution to this important tactical problem. Today the Stirling engine is the most favourable system. In the future, the fuel cell will be a better solution due to the higher energy output.

下一個要考慮的要素是作戰區域的水深及其他海水的條件，台灣海峽以及華東沿岸水深非常的淺。從台灣東北與東部到東南沿海具有較深的水深，海岸幾哩之外就有水深較深的大陸斜坡。許多潛艦人並不喜歡淺水區域，他們認為船艦會很容易被困住，而且沒有足夠的水深可供操作。這樣的論點並不完全正確，因為對一艘果敢的潛艦淺水區也同樣具有相當多的優勢。在淺水區，一般的音波圓弧擴散並不存

在，反而是所謂的音波渠道效應經常可見，這意味著能量將被海床及水面折射二者所吸收。由於波長太長的低頻無法擴散，所以使用拖曳式聲納的被動偵測將是非常的困難。而要在海床折射中找到小型的目標，低到中頻的主動聲納同樣也會面臨相當的困難。有限的水深造成水底地形與海面間的折射。海床也會降低深水炸彈的效能，而主動導向的反潛魚雷也將很難找到目標並分辨出目標潛艦與海床折射。另外，平坦多灘的水底地形也會使聲納回波減少，高頻的聲納雖可偵測到坐底的潛艦，但是其可能偵測的範圍僅限於幾百公尺之內。對潛艦而言，如何利用水底到水面之間的海水以避免被偵測到的知識及可能性是攸關潛艦存活的要素，這需要對台灣海峽水底聲學有完整而徹底的研究。

The next factor to consider is the depth and other conditions of the sea in the area of operations. The depth in the straits and along the eastern coast of China is very shallow. To Northeast, to the East and to Southeast of Taiwan, there are great depths, and the deep waters outside the continental shelf lies just some miles out from the Taiwan coast. Many submariners don't like shallow water. They think that the boat can be trapped and without any water to manoeuvre. That is partly true, but the shallow water also gives a lot of advantages to a boldly handled submarine. Normal spherical spreading is not existing in shallow waters, instead a channeling effect is the normal. That means that the energy is absorbed both in the seabed and in surface reflections, and that passive detection by using towed sonar arrays is very difficult due to the fact that the interesting low frequencies can't spread because the wavelength is too great. A low or medium frequency active sonar has equally great difficulties to find a small target in the bottom reverberation. The limited depth causes reverberation between the bottom topography and the surface. The bottom also reduces the efficiency of depth charges, and an active homing antisubmarine torpedo will have severe problem to find the target and to discriminate it from the bottom reflections. The relatively flat muddy bottom gives few bottom bounces. High frequency sonar can detect a submarine sitting on the bottom, but the range is just measured in some hundred meters. For a submariner the knowledge and possibilities to avoid detection by utilizing the whole water volume from the bottom to the surface are therefore essential for the survival of the boats. This demands a deep and thorough understanding of hydrography and hydroacoustics in the Taiwan Strait.

而潛艦指揮部也必須給指揮官有利用水深的可能，而勿因為超低頻通訊在時間上的限制而使他們喪失此一優勢。潛艦指揮部的通訊應該僅限於屬絕對必要的訊號，因為通訊時間上的限制，使得指揮官必須浮出危險水域以等待無線電訊號，如此一來就難以避免被偵測到並有效操作聲納。如果能讓指揮官充分地利用水深，他們將很快的成為海洋的主宰者。

But submarine command must also give the commanding officers the possibilities to utilize the depth and not hamper them by too short timeframes on the VLF traffic list. The information from the submarine command always has to be kept at a minimum just with the absolutely necessary signals. Too short timeframes has the results that the CO's will be hugging to the dangerous surface to wait for radio signals instead of avoiding being detected and searching the depths for sonar contacts. Let the CO's explore the depths – and they soon will be masters of the oceans.

誠如前述，華東沿岸及台灣海峽的水深並不深，這有利於不被長程聲納所偵測到，不過短淺的水域也同時增加了水雷的威脅。在第二次世界大戰期間，台灣海峽的大多數區域被宣布為水雷區。日本的船運緊貼著中國的海岸，並且藉由雷區的防護以躲開富侵略性的美軍潛艦。我認為在中國與台灣的衝突中，此一地區域的水雷威脅應當被重視。在某些敏感的區域，例如，基地、港口以及某些可以船運交通上的箝制點，水雷在此所產生的威脅將勝過其他區域。水雷威脅需要對於地球磁場差異的充分瞭解，並且需要有有效的三度空間中和磁場系統以降低船艦本身的磁訊號

I have already said that the eastern coast of China and the Taiwan Strait is not deep. This creates good possibilities to avoid detection from long range sonar. But the shallowness increases the mine threat. During WW II, most of the Taiwan Strait was declared dangerous to mines. The Japanese shipping hugged to the Chinese coast and took cover from the minefields in order to avoid the aggressive US submarines. In a conflict between PRC and Taiwan, I think that the mine threat in the area can be considerable. In sensitive areas, for example outside bases, harbors and at some choke points, where the shipping is channeled, the threat can be even more severe than in other places. The mine threat demands a good thorough knowledge of the differences in the earth's ma gnetic field and an effective three-dimensional degaussing system to minimize the magnetic signature of the boat.

在熱帶地區水表溫度在四季間的變化並不大，水溫通常在攝氏二十度左右。這將需要電瓶冷卻系統，否則電瓶將無法在長期的潛艦巡邏中發揮最大的效應。而一個可以循環電池酸的系統也將有利於增加不用呼吸管航行的時間。

The water surface temperature doesn't vary much during the yearly seasons in the zone of tropics. The water is generally around and above 20 degrees Celsius. This factor creates a need for a battery cooling system, otherwise the battery will not give its maximum during extended submarine patrols. A system to circulate the battery acid is also favourable for increasing the time between snorting.

由於在相對穩定的溫度，聲波不會受到太多季節和地形改變的影響，因此潛艦要藉由聲音的快速變化來尋求掩護的可能性將受到限制。然而，在台灣的東北部及東部水域因為水深較深，或有可能在深水處找到較低的溫度。

As a result of the relatively steady temperature, there is no large seasonal and geographical variation in the sound velocities. The possibilities to search for a rapid change of speed of sound to find cover is therefore limited. However, on the Northeast and on the East Coast of Taiwan, where the water is deeper it is possible to find lower temperatures at depth.

我認為在華東沿岸的水下視距是相當的低，這會增加了情報蒐集的困難度。

I have a feeling that visual distance under water is quite low on the East Coast of China. This increases the difficulties in intelligence gathering.

總結的說，華東沿岸或台灣海峽提供了潛艦許多避免被偵測到的機會，因此，潛艦將可能會對中國沿岸的海運產生嚴重的威脅。

To summarise the East Coast of China and the Taiwan Strait offer several opportunities for a submarine to avoid detection, and at the same time create a severe submarine threat to the PRC possibilities to use the coastal shipping lanes.

台灣潛艦戰術與作戰需求
Tactical and Operational Demands on a Taiwan Submarine

要保持躲台灣海峽這樣一個在熱帶區域，需要有非常靜音的潛艦並具有長期戰術與作戰的潛航能力，這樣的潛艦還必須配備有現代化聲納以及其他被動聲納。另其他武器像魚雷、水雷以及可能的攻陸飛彈都是非常有用的裝備。而且要能充分利用淺水區的作戰環境，優異的潛艦操縱性至為迫切。

To stay hidden in such a hot area as the Taiwan Strait, demands a very quiet submarine with long tactical and operational endurance and that the boat is equipped with modern sonar and other passive sensors. A variety of weapons such as torpedoes, mines and possibly ground attack missiles should be a strong staff requirement. An extremely good maneuverability will be needed in order to take full advantage of the shallow operational environment.

現代化的潛艦有不同的聲納系統。相較於一九四四年指揮官富魯奇和歐肯的潛艦作戰與現代潛艦作戰的最大不同之處，在於當時所常用的潛望鏡及可在水面操作的雷達已經不再是情蒐的主要感應器。使用潛望鏡時潛艦必須接近水面，而雷達訊號發射時，有可能暴露潛艦的位置。視潛望鏡的高度、目標的高度、波浪高度及能見度而定，潛望鏡不過能看到十至十五公里內的目標。如果沒有在戰術上正確操作的話——必須要減少主桅的暴露時間，降低主桅的高度並降低船速——潛望鏡很容易就會暴露出潛艦的位置。再則使用潛望鏡，也無法獲得太多值得需要冒著被偵測到之風險的資訊。現代化的聲納可在五到十倍以外的距離偵測到船艦，因此被視為船艦上最有用的感測器。

A modern submarine has several sensors. The big difference between Commander Fluckeys and O´Kanes submarine war 1944, and submarine operations today, is that the periscope (or radar on the surface as in the US case) is not anymore the primary sensor for surveillance. The periscope demands a tactic where the submarine has to work close to the surface while transmissions with radar reveal the presence of the submarine. The periscope can see to the horizon, maybe 10 to 15 kilometers depending on height of target, periscope height, wave height and visibility. The periscope easily reveals the presence of the boat if not operated tactically correct – with short mast exposures, low mast height and with slow boat speed. Still the periscope doesn't give that much information, that it is worthwhile the risk of being detected. Modern sonar's can detect cavitating ships at distances five or ten times as long and is therefore the most desired sensor on-

board.

當潛艦要構成對中國嚴重及長期的威脅時，現在有很多不同類型的聲納能夠幫助指揮官達成目的。長程偵測的低頻被動聲納結合 LOFAR 及 DEMON 科技將會對建立水面景象有很大的幫助。我認為在台灣附近的作戰區域，艦艏圓弧聲納及舷側聲納併用將最有利於台灣水域的作戰。而由於淺水區域的因素，其實並不太需要裝置拖曳式聲納，因為這樣的聲納必需要一直拖在水底以避免定位上的模糊，這樣一來，潛艦必須一直極低速的狀態下操作，導致不必要的能量消耗。另外，用高頻聲納來避免觸及魚雷將是非常重要的，特別是要進入被認為有佈雷危險的水域時。

Today there are many types of sonar that can be of great help for the CO, when fulfilling his important task to establish a severe and prolonged submarine threat to PRC. Low frequency passive sonar for long range detection together with LOFAR and DEMON technique will be of great help when establishing the surface picture. I think that a combination between Circular and Flank Array Sonar is the most favourable in the Taiwan area of operations. There is no need to install Towed Array Sonar due to the shallow water and that such sonar needs to be straight in the water to solve the bearing ambiguity. This creates a need for a tactic where the boat has to move at slow speed all the time. That consumes more energy than needed. High frequency sonar for mine avoidance is important when navigating in areas known or presumed to be dangerous because of mines.

現代化的電子支援系統可裝置於潛望鏡旁邊的天線作短程情報偵測之用，也可裝置在不同的主桅增加了許多情報偵測的能力。這樣的感應器對於要建立起潛艦四周水面或空中威脅的景象是很重要的。

Modern ESM with the antennas either in the periscope for close range work or in a separate mast add a lot to the intelligence gathering capabilities. Such a sensor is also of importance when establishing the surface and air threat picture in the area around the submarine.

由於地球磁場的不同對於潛艦作戰有相當重要的影響，現代化潛艦藉由中和磁場系統來應付三度空間的磁域。磁場中和系統乃藉由探測感測器與電腦加以操縱。探測感應器的裝置可以用來測量地球磁場以及潛艦間的互動，並可藉由電腦自動的加以調整這種三度中和磁場綜合系統內的線圈。一個好的磁場中和系統可以降低被磁異偵潛系統所偵測到與碰上磁性感應水雷的風險。

The differences in the earth's magnetic field has a significant importance to submarine warfare. Modern submarines are today protected by a degaussing system taking care of the three-dimensional magnetic field. The degaussing system is controlled through a sensor (probe) and a computer. The probe measures the magnetic field of the earth and the interaction from the submarine and automatically, by a computer, adjusts the current in the coils of the three-dimensional degaussing system. A good degaussing system decreases the risk of being detected by MAD systems and at the same time decreases the risk from magnetic bottom mines.

潛艦在可能遭布雷的區域操作時，必須面臨水雷在極近距離內爆炸的風險。因此潛艦必須設計能抗拒因水雷近距離爆炸所產生的震波。這可以用移動式載台的方式達成，而所謂移動式載台乃是將船員及重要機械都裝置在一種橡膠或鋼筋彈簧等避震物質中。

Submarines operating in mine infected waters have to face the risk that the boat causes a mine in the near vicinity to explode. Therefore such a submarine have to be designed to resist the shock from a standard mine-explosion at a distance quite close to the submarine. This is achieved by floating platforms where the crew and the important machinery are mounted on rubber or steel springs.

之前我已經說過，潛艦要能夠在台灣海峽這個熱帶區域裏長期保持靜音並隱匿起來，必須隨時抑制潛艦發出噪音。船員必須有良好訓練，並了解以較好的聲納表現及敵人較不足的偵測距離上達成靜音。船員也必須充分了解到幾個月間在技術進步與辛苦的工作的成果，很可能在幾秒鐘之內就被某個不小心的船員所破壞殆盡。

I said earlier that the boat has to be quiet to be able to stay hidden in such a hot area as the Taiwan Strait. The fight against noise transmitted from the submarine is a fight that never ends. The crew had to be well trained to understand what can be achieved with a quiet boat in terms of better own sonar performance and shorter enemy detection ranges. The crew must also be well aware what have been achieved during months of hard work technical innovations, can be destroyed in a minute by an uninterested crewmember.

華東沿海有些地方是中國交通自然匯集點，這是所謂的箝制點。這些箝制點可提供許多目標物及情報收集的好機會。然而，這些目標通常有護航，因此，要完成這樣的任務需要有勇敢與熟練的潛艦操作才能達成任務。有了優異的被動聲納與長程線導主動歸向魚雷後，潛艦通常可以靜坐水底或非常緩慢的速度前進，仍舊能抵達有利的偵搜與攻擊位置，這種耐心的戰術可節省能量及縮短電池重新充電所需的時間，而且可加強聲納的表現並降低遭偵測的危險。

A look at the chart covering the East Coast of China reveals some places with geographical constraints – choke points – where the PRC shipping is naturally concentrated. Such choke points could provide a lot of targets and good possibilities for intelligence gathering. However the targets are normally escorted and therefore bold and skilled submarining is needed to get the job done. But with good passive sensors long-range wire-guided and homing torpedoes, it is often possible to hover, to sit at the bottom or to move very slowly, and still achieve a good reconnaissance or attacking position. This patient tactic saves energy and limits the time needed to recharge the batteries. It also enhances sonar performances and reduces the risk of detection.

針對特種作戰所需要的蛙人進出隔離艙系統對現代潛艦而言越來越重要，因為特種作戰部對蒐集到的情報通常具有很高的價值。

A lockout capability for special operations has been more and more important in today's submarines due to the high value of intelligence collected by special forces.

混合水雷、魚雷以及面對面飛彈的武器攜載會給指揮官更多的選擇，並同時會增加中國預測在衝突中台灣潛艦將如何被使用的困難。

A weapon load with a mix of torpedoes, mines and surface to surface missiles can increase the COs choices a lot and at the same time, increasing the difficulties for PRC to predict how the Taiwan submarines will be used in case of an armed conflict.

潛艦在台灣附近水域操作必須能利用整體水文，此意味著台灣潛艦必須能在各種不同的水深下操作，從最淺只有二十到二十五公尺下降至東岸的三百到四百公尺，而且也要能從水底到水面間皆可操作。

A submarine operating in the waters in Taiwan's vicinity must be able to utilize the whole water volume. That means to be able to operate in depths of water that varies from just some 20 - 25 meters down to 300-400 meters east of Taiwan and also to operate from or close to the bottom to the surface.

因此，潛艦必需要能充分利用水底背景地形，盡可能的貼近其垂直或平面的海床表面，並試著能在坐底的情況下仍能使用其聲納及武器。

Hereby the submarine can use the background topography fully to its own advantage by operating as close as possible to the vertical or horizontal bottom, or try to be in a position on the bottom, but still be able to use it's sensors and weapons.

這需要相當優異的垂直與水平的操控功能，並具有優異的重量補償系統。瑞典解決此一問題的方案，乃採用 X 型的潛艦尾舵設計並配合單人操作的舵台。這唯一的舵手能直接操作注水並調整水艙以控制船的方向與深度。此一解決方案能使潛艦有較短的迴轉半徑，並能在接近水底時仍有良好的舵效。例如，在潛艦下潛時仍能倒車而不成問題。再則，由於潛艦的船殼形狀其及尾舵設計，即使在低速下亦能使迴轉半徑小過艦身長度。此乃潛艦在淺水區域內貼近海底操作時所想要有的性能。另外，控制系統可讓舵手操作潛艦時更為容易改變方向與深度，而不論潛艦的速度如何。

This demands extremely good maneuverability both in the vertical and horizontal planes as well as a good weight compensating system. The Swedish solution to this problem has been to design the boats with X-rudder configurations and a one-man steering console. The only helmsman operates both the compensating water as well as the trim water and steers the boat in course and depth. This solution makes it possible to get a short turning radius and quick rudder reaction when operating near the bottom. For example, it is no problem to go backwards with the submarine submerged. Due to the shape of the submarine's hull and their rudder configuration, a turning radius less than the boats own length, is also possible to achieve, in even at low speed. This is a desirable feature when operating in shallow waters near the bottom. The control-system

makes it very easy for the only helmsman to control the submarine both in course and depth at the same time, regardless of the speed of the submarine.

用來在淺水區域操作的潛艦在設計與建造上須注意到要能在低速碰撞海底仍不會有太大的傷害。X 型尾舵設計可讓潛艦靜坐海底而免於損及尾舵與推進器，而縱使在潛艦坐底的情況下，聲納（即使是舷側聲納）仍然能繼續操作。

A submarine designed to operate in shallow waters have to be designed and built to be able to safely hit the seabed at low speeds without sustaining any substantial damages. The X-rudder configuration mentioned above makes it possible to sit on the sea-bottom with very little risk of damaging the rudders and the propeller. The sonar arrays (even the Flank array Sonar) will continue to function even if the submarine is sitting on the bottom.

要在台灣水域執行潛艦作戰另一考量要素是，潛艦通常在海裏要比在基地安全。中國具有能從空中突襲台灣海軍基地的能力，一旦區域緊張升高，我認為最重要的是台灣潛艦要能立刻離開他們的駐地，並且疏散，而潛艦應盡可能坐底等待補給，因為那將比起待在港口坐視中國空襲來的好。當補給抵達時潛艦可上浮，並停泊在補給船旁進行補給。這雖然需要一強大並富有彈性的補給系統組織，但也將因此降低高價值潛艦的威脅。瑞典更進一步的解決方案是，我們的潛艦可使用海床進行修復並進行兩個任務間對主電池重新充電的工作。潛艦本身有的發電器可將主要電池充滿。我們的潛艦能在使用很少補給船的情況下，在一個晚上完成包括武器在內的裝載。

Another important factor to consider for a successful submarine warfare in the Taiwan water, is that a submarine is safer at sea than in the base area. The PRC have the capability to strike at the Taiwan naval bases from the air. I case of a higher tension in the area, I think it is of outmost importance that the Taiwan submarines immediately leaves their normal bases. To spread the boats and possibly to sit on the bottom awaiting replenishment, is a better solution then to wait in the harbor for a PRC air raid. When the replenishment arrives, the submarine can surface and be at anchor when the replenishment comes by boat. This will support the need for a strong and flexible logistic support organisation, but it will pay of with a reduced threat against the valuable submarines. The Swedish solution has gone even further. Our submarines are capable of using the seabed while conducting repairs or recharging the main batteries between missions. The submarines own generators are capable of charging the main batteries to full capacity even with low current in the later stages of the charging process. The submarines can be fully stored, including weapons, within one night, just by using small tenders.

如果我們仔細考慮到在台灣附近水域潛艦作戰的可能性，我們會得到一個結論：那就是一艘勇敢並富技巧的潛艦，具有比起反潛兵力多上許多的優勢。而許多科技上的解決方案可用來克服潛艦在淺水區域以及缺乏聲音速度變化所能帶來保護等的問題。而聲納將很難偵測並攻擊一艘在接近海底操作的潛艦。

When carefully considering the operational possibilities in the area around Taiwan

it is clear that a submarine boldly and skilled handled have many advantages over the ASW forces. There are technical solutions to overcome the problems with the shallow water and absence of a protecting change in speed of sound. A submarine operated near the bottom will be extremely difficult to detect and attack by using sonar.

若就威脅程度而言，結論是很明顯的，一艘能正確使用戰術技能的潛艦其作戰的機會將大過於成功執行反潛作戰的可能性。

The conclusion is obvious, that if a submarine, in view of the threats, is used in a correct tactical manner, the opportunities for submarine warfare is considerably better than the possibilities for successful ASW.

結論
Conclusion

一支強大的潛艦武力是台灣現代化兵力結構中的重要基石。現代化潛艦可以將戰爭帶向整個中國沿岸敵境，這是非常有價值的，因其會帶給中國開始橫越海峽發動攻擊時制海上的許多問題。而這樣積極的使用潛艦同樣也可以減少台灣海軍遭封鎖的風險，因為對於中國的主要船隻而言，離開他們的港口將是相當的危險。此一作戰概念上的改變，將會使中國退居防禦式的角色，而對台灣有利。現代化潛艦可以改變整個華東的戰略態勢，以有利於台灣及其安全政策。台灣潛艦在作戰上將是難以預料，並且很難加以偵測及摧毀。因此，現代化潛艦必須要在台灣的優先採購名單上。

A strong submarine force can be the cornerstone in a new modern force structure for Taiwan. Modern submarines that can take the war to the enemy along the whole China coast, is very valuable and will create severe problem for PRC to gain the necessary control at sea before the start of an invasion across the Taiwan Strait. Such aggressive operational use of the submarines will also reduce the risk of a naval blockade against Taiwan because it will be dangerous for the major surface PRC ships to leave harbor. A forced change of operational concept up on PRC to a more defensive role will turn the tide in Taiwan favour. Modern submarines can change the whole strategic situation in the East China region in favour for Taiwan and it's security policy. They are unpredictable in their operations and extremely difficult to detect and destroy. Modern submarines must therefore stand in the front of the Taiwan shopping list.

華東沿岸及台灣海峽非常的淺。一般認為其對潛艦作戰相當不利，但我認為這對於一旦戰爭應盡量將潛艦作戰帶進敵境的台灣潛艦兵力不太適用。中國帳面上雖有強大的海軍及潛艦兵力，但許多艦隻均已老舊，而且基本上也非設計來用於短淺水域操作。不過，一旦中國發動潛艦攻勢，一樣也會造成台灣反潛兵力在偵測與摧毀的困難。中國的反潛兵力並不適合於淺水區域的反潛作戰，在台灣附近水域具有相當大海底折射的情況下，中國所有的低頻與中頻聲納將無法發揮優勢。中國的基洛型潛艦在科技上十分先進也相當靜音。然而，它們將很難能偵測到在非常淺的水域中操作的小型或中型潛艦。根據我對作戰因素與中國艦隻的研究，我強烈建議台

灣的潛艦應儘量遠離台灣東部的深水水域，並且集中使用在中國沿岸。這是基於兩個主要原因：中國的反潛兵力比較有可能在深水區域偵測到並摧毀台灣的潛艦，而且台灣比較容易在中國沿岸找到具有價值的目標。一旦區域緊張情勢升高，我建議台灣應立刻造成對中國華東沿岸的潛艦威脅。因此，進一步研究中國的弱點以及其有價值的作戰目標將是需要的，將會有助於瞭解派駐潛艦的作戰區域。

The East Coast of China and the Straits of Taiwan is very shallow. This is normally considered to be a strong negative factor for submarine warfare. I think that this is not the case for the Taiwan submarine Force who in case of war needs to take the submarine war close to the enemy. The PRC has on the paper a strong navy and submarine Force. Many of the ships are of older origin and are originally not intended to operate in these shallow waters. But if they do, the PRC submarines are equally hard to detect and destroy for the Taiwan ASW forces. The PRC ASW forces are not well suited for shallow water ASW. The low and medium frequency sonar in those ships will not be to their advantage when operating in waters with an extremely high bottom reverberation. The modern PRC submarines of the Russian Kilo type is a technically advanced and quiet submarine. However they will have severe difficulties to detect small or medium seized submarines operating very shallow. As a result of my studies of the operational factors and the PRC ASW ships, I strongly recommend that the Taiwan submarine Force stay out of the deep waters east of Taiwan and concentrate its efforts along the coast of China. There are mainly two reasons for that. The PRC ASW forces will be better adapted to detect and destroy Taiwan submarines in the deep water and it will be much easier for Taiwan to find valuable targets on the coast of China. In case of a higher tension in the area I therefore recommend that Taiwan immediately establish a submarine threat along the East Coast of China. A closer study of the PRC weak points and valuable operative targets will be needed and will then give guidance of which areas to assign to the boats.

如同前述，在淺水水域需要特別的科技解決方案。最主要的是要克服傳統柴電潛艦的最重要的弱點：要上浮到潛望鏡深度來重新為電瓶充電，這是在淺水與狹海水域主要的戰術上缺陷。另外，機載雷達及紅外線偵測正日益進步，以呼吸管換氣的潛艦將倍感威脅。

The shallow waters demand special technical solutions as mentioned earlier. The most important part is to overcome the primary disadvantage of the conventional diesel electric submarine - the need to come to periscope depth to recharge the main batteries. This is a substantial tactical drawback especially in shallow and confined waters. Furthermore, continued advances in the development of airborne radar and infrared sensor capability have increased the threat against a snorting submarine.

為了要減少使用呼吸管的時間以增加不需要呼吸管航行的時間比例，瑞典海軍尋求最符合其需要的絕氣推進科技。一九九八年原型絕氣推進系統被裝載在頸級（A14 級）潛艦上以進行海上測試。經一系列的測試及修正後，決定採用史塔林引擎系統，除了傳統的柴油引擎，所有三艘新的哥特蘭級（A19 級）潛艦（一九九九年服役）均裝載這樣的引擎。而最新的決定是要將同樣的技術裝載在二至四艘的西哥特蘭級（A17 級）潛艦上。

In order to reduce the time required to snort, and thereby improve the indiscretion ratio, the Swedish Navy has sought to identify an AIP technology that best suited our needs. In 1988 an AIP prototype system was installed in the *Näcken* class (A 14) submarine for trials at sea. Subsequent test's, trials and refinements to the design resulted in the decision to install Stirling engine plants, in addition to the normal diesel engines, in all three of the new *Gotland* class (A 19) submarines (operative 1999). And recently a decision was taken to install the same type of machinery in two, and hopefully soon in all the four of the *Västergötland* class (A 17).

使用絕氣推進系統，潛艦指揮官能有較多的作戰模式選項。當對反潛的威脅接近時，他可選擇使用電瓶；當威脅不是那麼顯著時，他可使用絕氣推進系統；而當威脅更小的時，他可使用一般的柴油引擎或使用呼吸管呼吸。目前絕氣推進系統可使夠使潛艦在正常速度下操作時仍能提供充分的能量以保持電池滿載。這意味著在巡邏的百分之八十至九十的時間將會使用絕氣推進系統，而在高速行進時，使用電瓶，而在速度降低時，電瓶自動充電。

By using AIP, the submarine commander can select his operational profile. When the threat against the submarine is acute, the battery is used. For lesser threats, the AIP is used and with even lesser threats, the regular diesels are used while snorkeling. Today's AIP system supplies sufficient energy to keep the battery loaded (floating the load) and still run the submarine at normal submarine speeds. This means that operating on AIP can cover 80 – 90 % of the time in the patrol area. For greater speeds the battery is used and is automatically charged when the speed is reduced.

由於史塔林系統為往復式可控性燃燒，本身非常安靜，而且能藉由安裝雙重的彈性裝置以及一種聲音音罩更為降低噪音散播。同時，燃燒後的瓦斯乃以一種可控制的方式排出海裏，這種方式不會留下熱泡的尾跡。

The Stirling system is inherently silent due to the fact that the combustion takes place in continuous and controlled manner. The low noise is further reduced by the double-elastic mounting arrangements and an acoustic hood reduces the airborne noise. In addition, the exhaust gas is let out into the sea in a controlled way through a unique arrangement that leaves, in practice, no trace of bubbles or heat.

絕氣推進系統可明顯的增強不須呼吸管換氣的時間比例。有了史塔林引擎之後，水下的戰術耐海性可從幾天延長至幾週的時間，因之，可增加作戰的時間並降低停留在基地的時間。不過，也因此需要較多燃料、二氧化碳吸收器、氧氣的補給以及在一般的柴電引擎之外的備用引擎，同時較長的巡邏的時間也會增加補給支援組織的負擔。

An AIP capability improves the indiscretion ratio significantly. With Stirling engines onboard, underwater tactical endurance can be increased from a few days to several weeks. This supports an increase of operation times and minimizes the time spent in base areas. But it also demands large stores of fuel, carbon dioxide absorbent, oxygen,

supplies and/or auxiliary engines alongside the usual diesel – electric propulsion. An extended patrol time will increase the burden on the logistic support organisation.

在近岸水域的操作，須有被動聲納以便能在多重目標環境中（高背景噪音）有高度的定位解析。此一聲納能夠涵蓋大部分的頻寬，而避免強大主動聲納的干擾。較大的頻寬對於收錄敵方聲響情報將極為重要。

Operations in the littorals also demand that the passive sensors give you a high bearing resolution in a multitarget environment (high background noise). They should cover a large part of the frequency band to make it possible to avoid interference from strong active transmitters. Wide frequency coverage is also important for good recordings when collecting acoustic intelligence.

其他在潛艦建造時比較一般性的需求，就是要低目標能見度、低噪音率以及有效的中和磁場系統，而有坐底的能力也是重要的要件。對瑞典而言，X 型尾舵以及一人控制的舵台設計還算蠻可靠的。

Other demands are the usual ones, when constructing and building submarines, low target strength, low noise level and an efficient degaussing system. The need to sit on the bottom now and then, is an important staff requirement. The x-rudder configuration and one-man steering console has been very reliable for Sweden.

潛艦武器的發展和潛艦的建造具有相當關聯。我認為潛艦要結合重型及輕型的魚雷、水雷及陸攻飛彈。因為，台灣的海軍指揮官在面對多重目標的危機時，將迫切需要有極大的反應彈性。而潛艦在武器搭載上的彈性，將能增加中國對於台灣潛艦將如何使用的不確定性，同時也會增加在武裝衝突中成功的可能性。

The weapon development follows the construction of a modern submarine closely. I believe in a combination of heavy and lightweight torpedoes, mines and ground attack missiles. The Taiwan naval commanders have to have optimum flexibility when facing a multitarget crisis. Flexibility in the submarines weapon load will increase the PRC uncertainty how the Taiwan boats will be used. That will increase the factors for success in case of an armed conflict.

最後，我認為具有六到八艘強大的台灣現代化潛艦在華東沿岸水域操作，將可改變整個華東地區的戰略態勢。這樣的潛艦將增加中國對台灣作戰意圖的不確定性因而會綁住中國的海軍資源。同時這也會最小化台灣遭中國海軍封鎖的風險並降低中國經由短淺的台灣海峽發動攻擊的可能。

Finally I am convinced that a strong modern Taiwan submarine Force of six to eight boats boldly operated in the shallow waters on the east coast of China can change the strategic situation in the east China region. Such a submarine Force will increase the PRC uncertainty of Taiwan intentions and thereby tie up naval resources. This will minimize the risk of a PRC naval blockade as well as minimizing the risk for an invasion across the shallow Taiwan Strait.

基於此，對台灣而言，應繼續與那些可以提供現代化潛艦以及能在威脅發生時提供協助或能在海軍作戰的諸多領域中夠提供資源的國家營造良好的海軍關係。而要確定未來潛艦設計與建造國，對台灣將至為重要。■

Due to this fact, is it important that Taiwan continue to build strong naval relationships to countries that could provide the modern submarines and that could come to assistance in case of a conflict as well as a to give continued support in many fields of naval warfare. To identify a prospective submarine design and building country will be of outmost importance for Taiwan.■