ATOLLS UPON WHICH SIGNIFICANT NUCLEAR FALLOUT COULD HAVE OCCURRED

FROM THE

PACIFIC PROVING GROUNDS

DURING

ATMOSPHERIC TESTING

DRAFT

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In light of recent developments on BIKINI and ENIWETOK atolls it is prudent that some consideration be given to fallout from the Pacific Proving Grounds which may have been carried to other atolls during the period of atmospheric testing.

Fallout patterns and other pertinent data on the various nuclear tests are very limited. However, hodographs are known for nearly all of the tests conducted in the Pacific. These hodographs and available fallout patterns have been studied to discern which events may have had significant fallout on Pacific atolls. Those hodographs and fallout patterns which have positive indications or suggest significant fallout on these atolls are indicated, as well as the source of such information.

Due to the intensive fallout from the CASTLE BRAVO event on RONGELAP and UTIRIK atolls, some effort was made in the past to investigate the radioactive deposition on these and a few other atolls in the fallout pattern. Unfortunately, the utility of these investigations is limited due to the small number of atolls visited, the now primitive treatment of the samples (gross gamma, gross beta, and other crude evaluations), and age of the survey. Only on RONGELAP, BIKINI and ENIWETOK atolls have any recent studies been undertaken. The rest of the fallout area apparently has been ignored.

Utilizing various reports, fallout patterns and hodographs, this investigator has evaluated the data available, realizing its limitations, and thus the limitations of such a study, and suggests that possible significant fallout has occurred on several atolls which do not appear to have been investigated previously. This fallout, or the hodographs suggesting it, is presented as figures with other pertinent information presented in tabular form for brevity.

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COMMENTS ON SOURCE INFORMATION

Fallout Patterns

The source documents (~~indicated~~ listed in the References portion of this report) indicate the ~~dose~~ rate contours for the fallout patterns have been drawn to show the gamma ~~dose~~ rate in roentgens per hour, three feet above the ground, in terms of the one hour after burst reference time. The $t^{-1.2}$ approximation was used when no actual decay data was available to adjust radiation measurements to the one hour reference time. It is important to recognize the H + 1 hour is used as a reference time, and that only the contours from low yield were complete at one hour after burst. For high yield weapons, fallout over some parts of the vast areas shown did not commence until many hours after burst.

Where several fallout patterns were available for a particular event, each has been presented.

Hodographs

The hodographs were drawn for a constant balloon rise rate of 5,000 ft/hr and are presented because other, more meaningful, information is not available. Several hodographs are ~~indicated~~ presented for the H plus times indicated by the number at the end of the arrow. This number is in H plus hours.

It is recognized that fallout did not necessarily follow the hodographs presented herein. However, a simple comparison of the CASTLE BRAVO hodographs with the actual or modeled fallout patterns will show the merit of their consideration.

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FINDINGS

~~Apparently~~ There are eleven nuclear tests which may have deposited radioactive materials in significant amounts greater than world wide fallout on several of the Pacific Atolls. These events and the atolls they may have contaminated are indicated in tabular form in Table 1. Additionally, the fallout pattern, if available, or several hodographs are indicated in Figures ___ through ___, for each contaminating event. ~~XXXXX~~ For immediate reference, the habitation of the atolls under discussion is indicated, with population figures and remarks, where applicable, in Table 2.

It is pertinent to note that in addition to ENIWETOK, BIKINI, AILINGINAE, RONGELAP, RONGERIK, BIKAR, TAKA, ~~XXX~~ UTIRIK, and LIKIEP atolls, which have been looked at by others at some time in the past, several other atolls are indicated: AILUK, JEMO, KWAJALEIN, LAE, MEJIT, TAONGI, UJAE, UJELANG, WOTHO ~~XXX~~ and WOTJE. Since the utility of the studies ~~done~~ on BIKAR, TAKA, LIKIEP and possibly AILINGINAE ~~XXX~~ RONGERIK, and UTIRIK, is somewhat limited, these may also added to the exceptions above. This would mean that, including the "source" atolls of ENIWETOK and BIKINI, a total of 19 atolls may have been contaminated with significant amounts of radioactive materials. Only on three, ENIWETOK, BIKINI and RONGELAP, possibly four if UTIRIK is included, is there any useful ~~environmental~~ radiological data.

Since actual fallout patterns are lacking for ~~most~~ of the ~~contaminating~~ suspicious events, an attempt was made to weigh the potential of each event ~~in such a manner~~ as to make sense. ~~Since~~ As the fallout pattern of the CASTLE BRAVO event is well known (actually there are three different fallout patterns available) this deposition potential was normalized to ~~that event.~~ CASTLE BRAVO. ~~this~~ The result treatment ~~is~~ are presented in Table 3. The potential expressed here is really a factor, or multiplier, of the CASTLE BRAVO fallout. It may be applied simply by taking the CASTLE BRAVO deposition at a distance from the GZ ~~and~~

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similar to the distance from GZ, along the hodograph, of the event ~~in question~~, and multiplying it by the "potential" factor. The result should be a "ballpark" estimate of what fallout may have occurred at the location in question. Obviously, there is no claim to any precision or accuracy with this method. It is only offered as a crude mechanism to estimate ~~the~~ possible deposition in the absence of actual data. ~~It is a crude attempt at scaling.~~

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TABLE 1. POSSIBLE SIGNIFICANT NUCLEAR FALLOUT FROM PACIFIC PROVING GROUNDS, SUSPECTED ATOLLS

BLACK = POSITIVE RED = POSSIBLE

EVENT			ATOLL
SANDSTONE ZEBRA	6/[illegible]	T	ENIWETOK, BIKINI, AILINGINAE, RONGELAP, RONGERIK, TAKA, BIKAR, UTIRIK
GREENHOUSE DOG	4/51	T	ENIWETOK, UJELANG
GREENHOUSE GEORGE	5/51	T	ENIWETOK, BIKINI, AILINGINAE, RONGELAP, RONGERIK
IVY KING	11/52	M	ENIWETOK, UJELANG, *
CASTLE BRAVO	2/54	S	BIKINI, AILINGINAE, RONGELAP, RONGERIK, TAKA, BIKAR, AILUK, LIKIEP, JEMO, UTIRIK, WOTHO, KWAJALEIN, WOTJE
CASTLE UNION	4/54	B	BIKINI, AILINGINAE, RONGELAP, RONGERIK, TAKA, BIKAR, TAONGI, UTIRIK
CASTLE YANKEE	5/54	B	BIKINI, AILINGINAE, RONGELAP, RONGERIK, BIKAR, TAONGI
REDWING ZUNI	5/56	S	BIKINI, AILINGINAE, RONGELAP, RONGERIK
REDWING LACROSSE	5/56	S	ENIWETOK, BIKINI, AILINGINAE, RONGELAP, RONGERIK, BIKAR, TAONGI
HARDTACK MAGNOLIA	5/58	B	ENIWETOK, UJELANG, *
HARDTACK MAPLE	6/58	B	BIKINI, AILINGINAE, RONGELAP, RONGERIK, WOTHO, UJAE, LAE, KWAJALEIN

* This hodograph indicated that the fallout pattern could have extended southwest as far as Ponape and other nearby atolls.

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TABLE 2. HABITATION OF ATOLLS UNDER DISCUSSION

ATOLL or ISLAND	INHABITED (Pop.) yr.	BEING REINHABITED	UNINHABITED	REMARKS
ADLINGINAE			X	Visited by Rongelapese
AILUK	(395) 1962[1]		X	
BIKAR		X		
BIKINI		X		
ENIWETOK			X	
JEMO				
KWAJALEIN	(>1000) 1973[2]			
LAE	(133) 1962[1]			
LIKIEP	(662) 1962[1]			
MEJIT	(203) 1962[1]			
RONGELAP	(208) 1962[1]		X	Visited by Rongelapese
RONGERIK			X	Visited by Utirikese
TAKA			X	
TAONGI				
UJAE	(146) 1962[1]			

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TABLE 2. Continued

ATOLL or ISLAND	INHABITED (Pop.) yr.	BEING REINHABITED	UNINHABITED	REMARKS
UJELANG	(340) 1973[3]			
UTIRIK	(319) 1962[1]			
WOTHO	(56) 1962[1]			
WOTJE	(463) 1962[1]			

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1 _____, SAILING DIRECTIONS FOR THE PACIFIC ISLANDS, H. O. Pub. No. 82, Vol. I., U. S. Naval Oceanographic Office, 1964, (Chapter 5, Marshall Islands), Change 4 Incorporated, 5 December 1970.

2 Henderson, John W., et. al., AREA HANDBOOK FOR OCEANIA, U. S. Government Printing Office, Washington, 1971, p. 503.

3 Tobin, J. A., THE ENEWETAK ATOLL PEOPLE, Special Report for the Radiological Survey of 1972-1973, Majuro, 20 April 1973, p. 10.

TABLE 3. DEPOSITION POTENTIAL NORMALIZED TO BRAVO

EVENT	POTENTIAL
SANDSTONE ZEBRA	0.002
GREENHOUSE DOG	0.010
GREENHOUSE GEORGE	0.025
IVY KING	0.069
CASTLE BRAVO	1.000
CASTLE UNION	0.720
CASTLE YANKEE	1.050
REDWING ZUNI	0.070
REDWING LACROSS	0.035
HARDTACK MAGNOLIA	0.007
HARDTACK MAPLE	0.027

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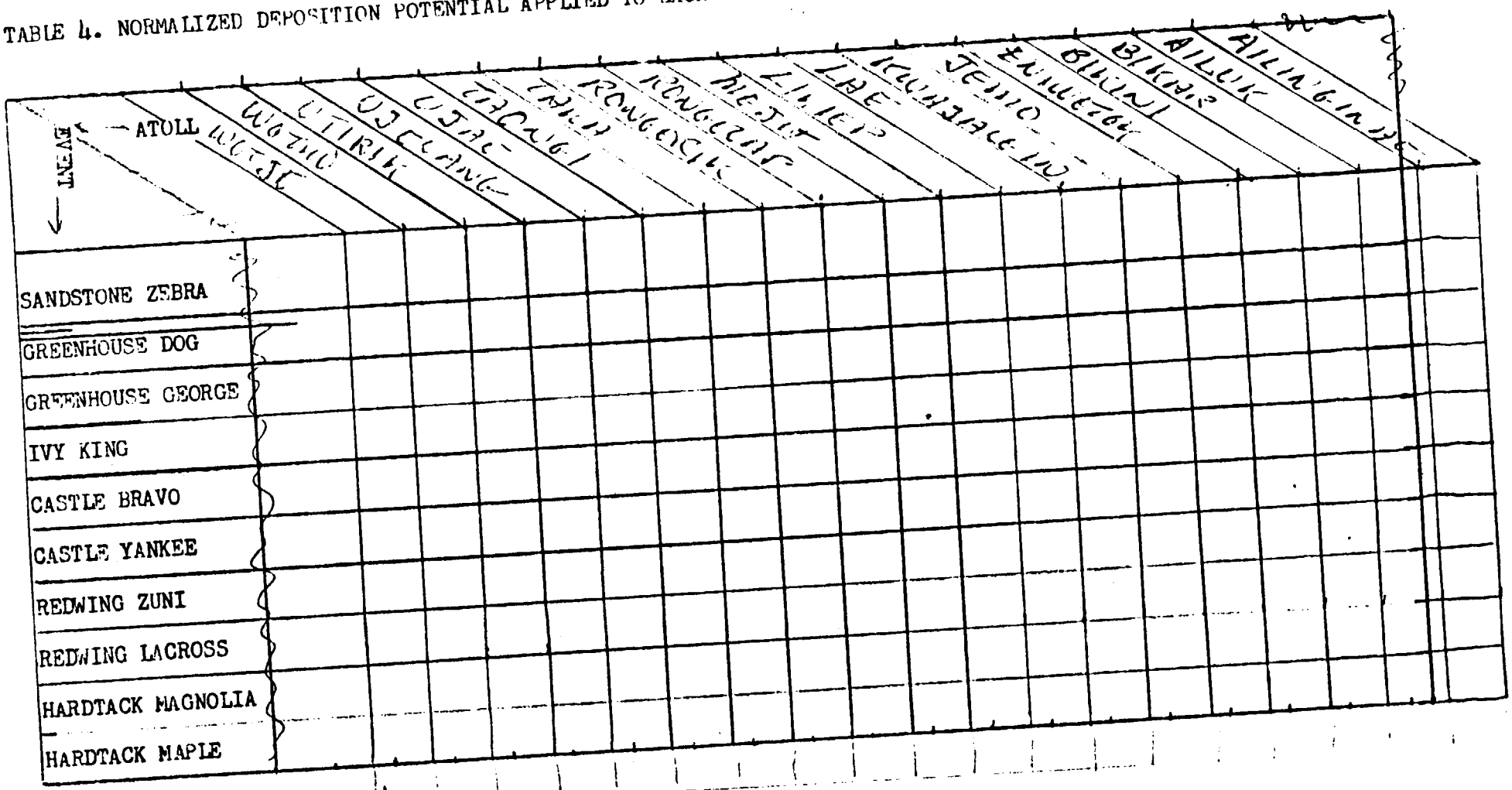
TABLE 4. NORMALIZED DEPOSITION POTENTIAL APPLIED TO EACH ATOLL BY CONTAMINATING EVENT



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ATOLLS ON WHICH SIGNIFICANT NUCLEAR FALLOUT COULD HAVE OCCURRED FROM THE PACIFIC PROVING GROUNDS

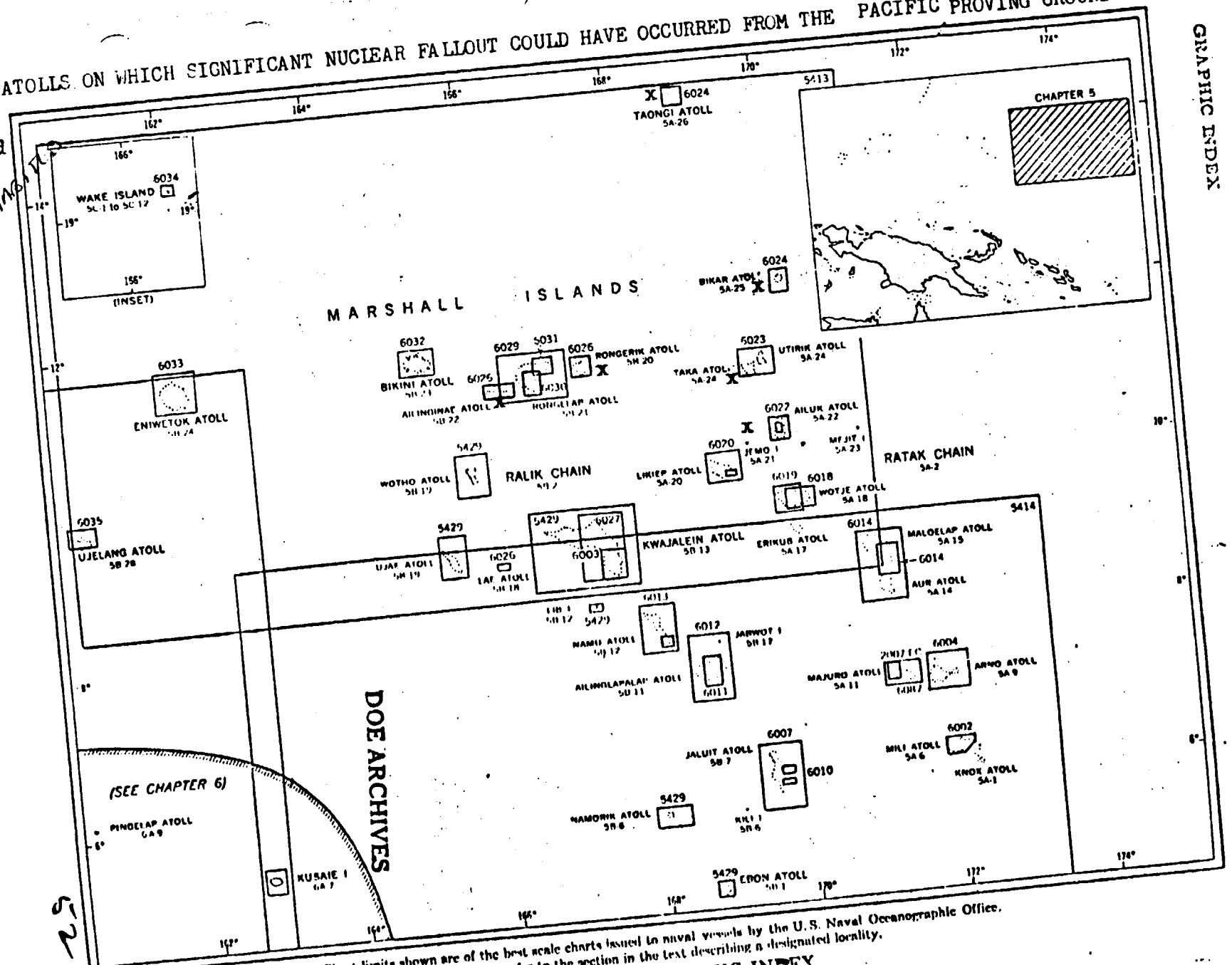

Chart limits shown are of the best scale charts issued to naval vessels by the U.S. Naval Oceanographic Office.

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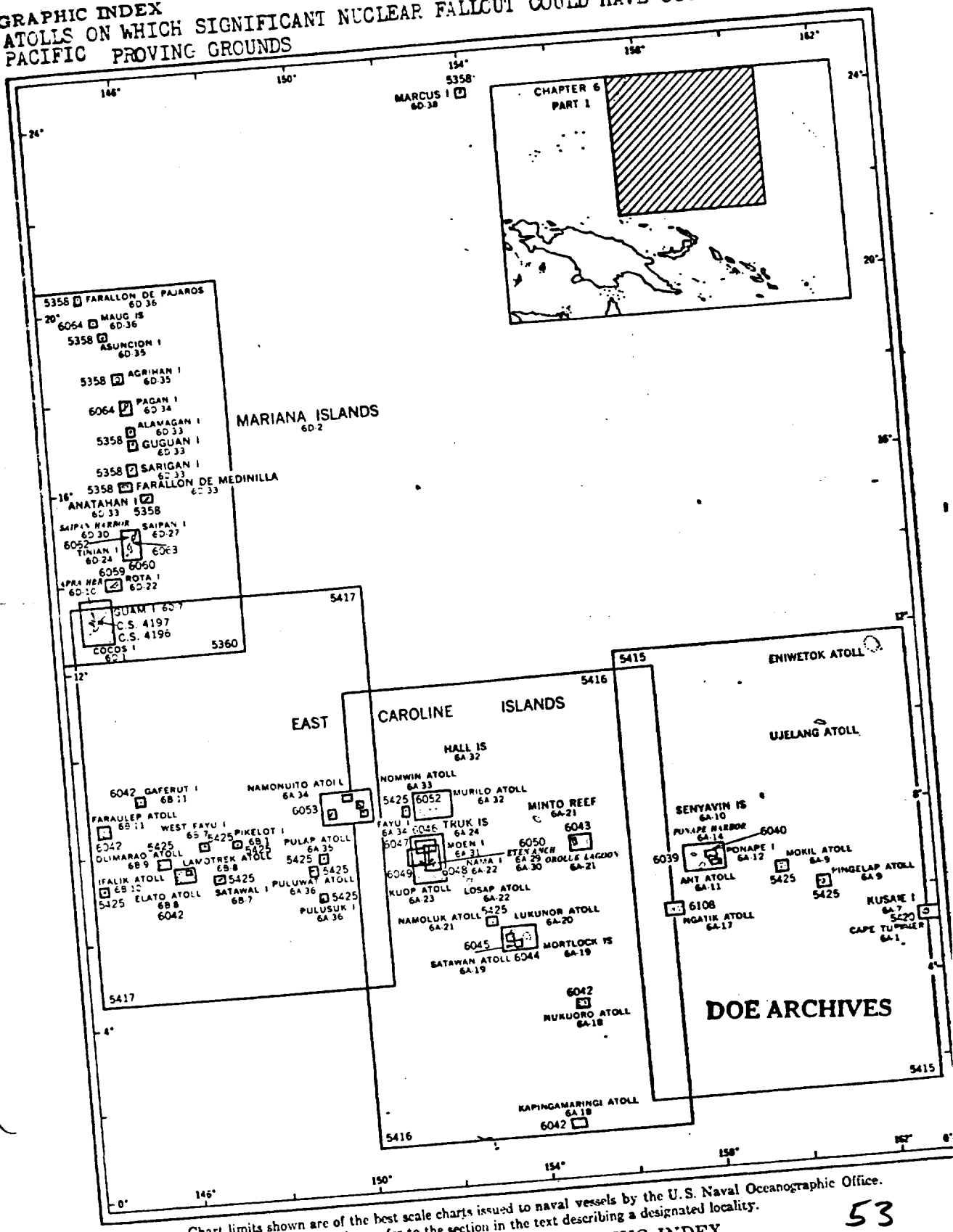
ATOLLS ON WHICH SIGNIFICANT NUCLEAR FALLOUT COULD HAVE OCCURRED FROM THE PACIFIC PROVING GROUNDS



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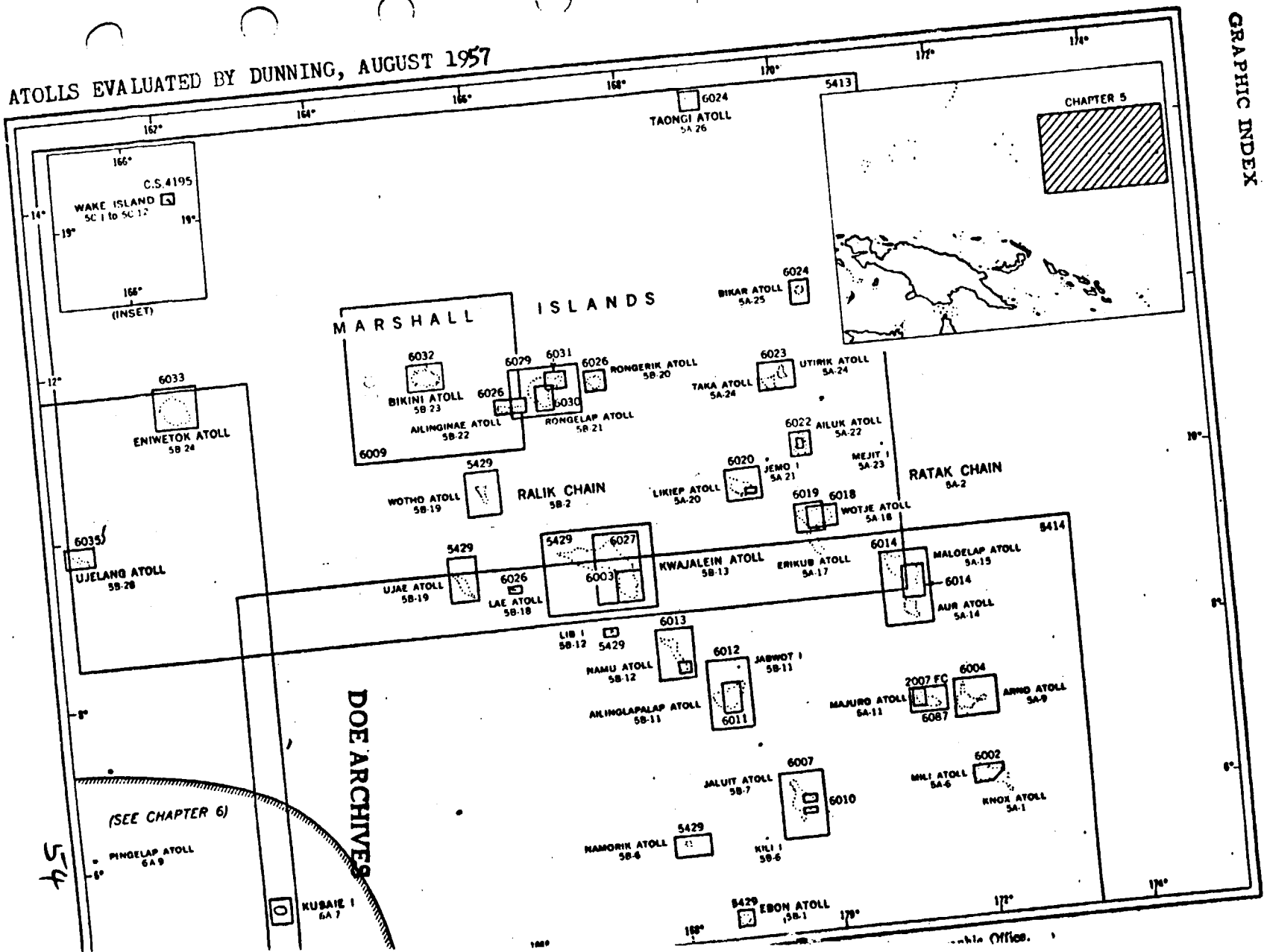
ATOLLS EVALUATED BY DUNNING, AUGUST 1957



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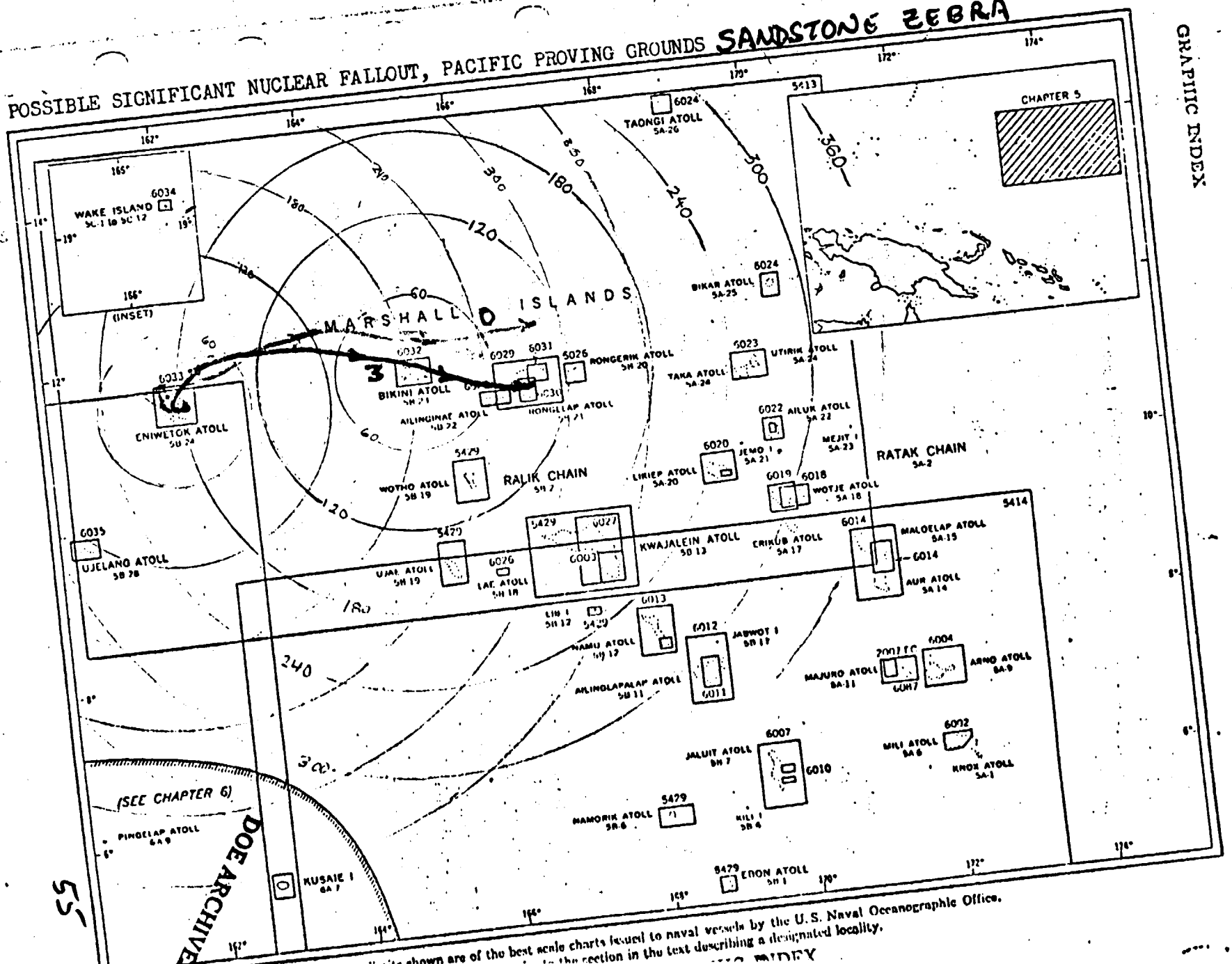

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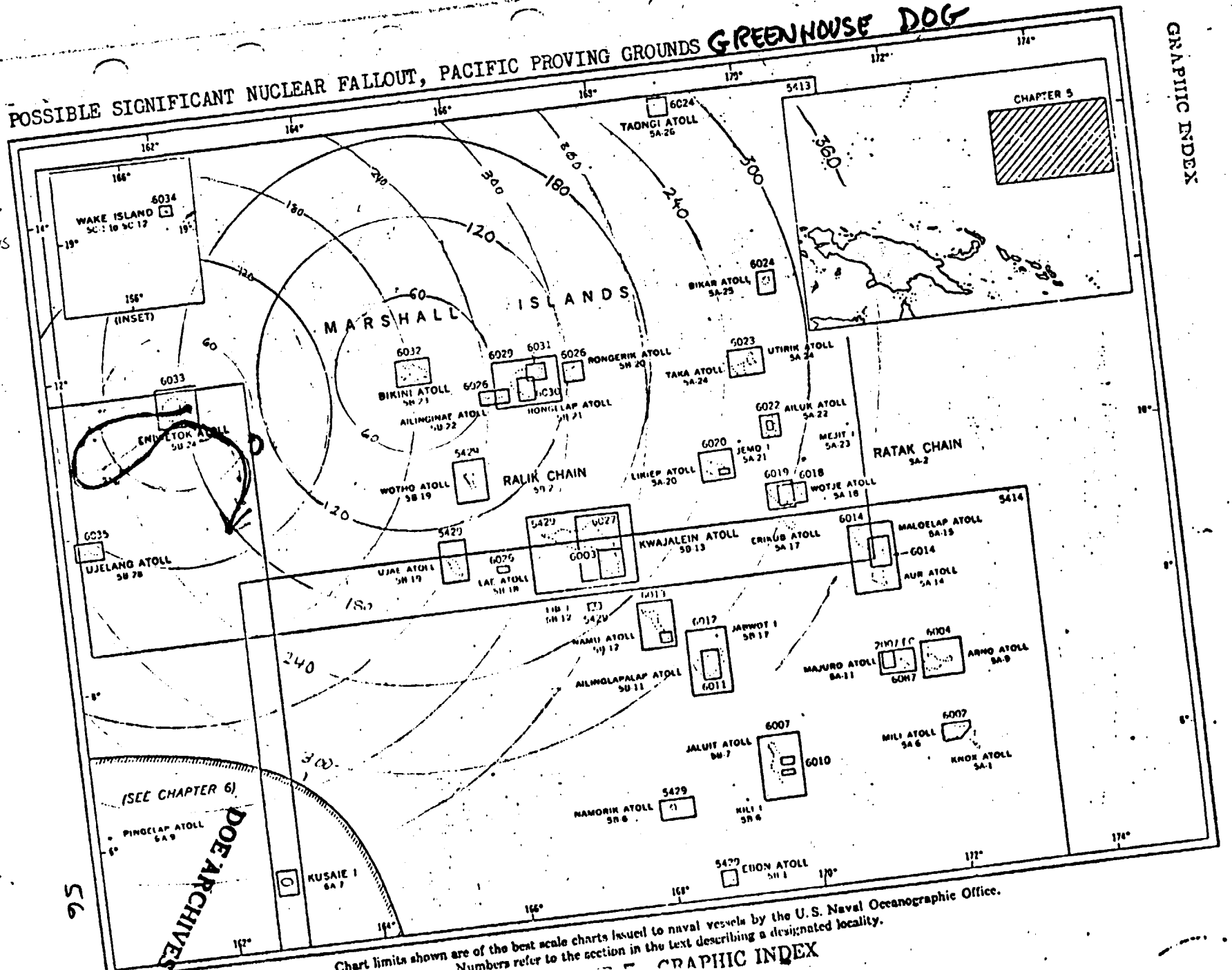
POSSIBLE SIGNIFICANT NUCLEAR FALLOUT, PACIFIC PROVING GROUNDS GREENHOUSE DOG



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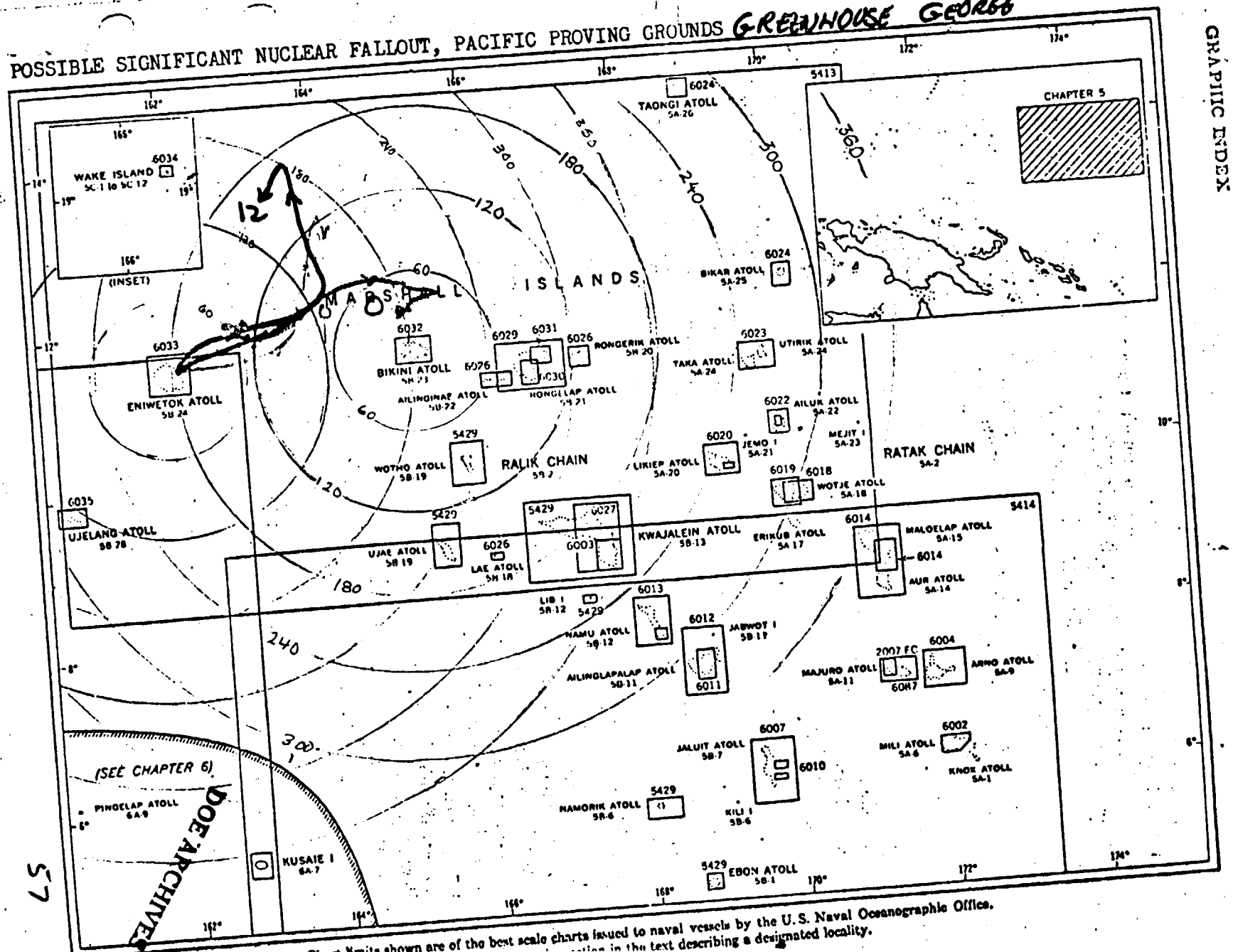

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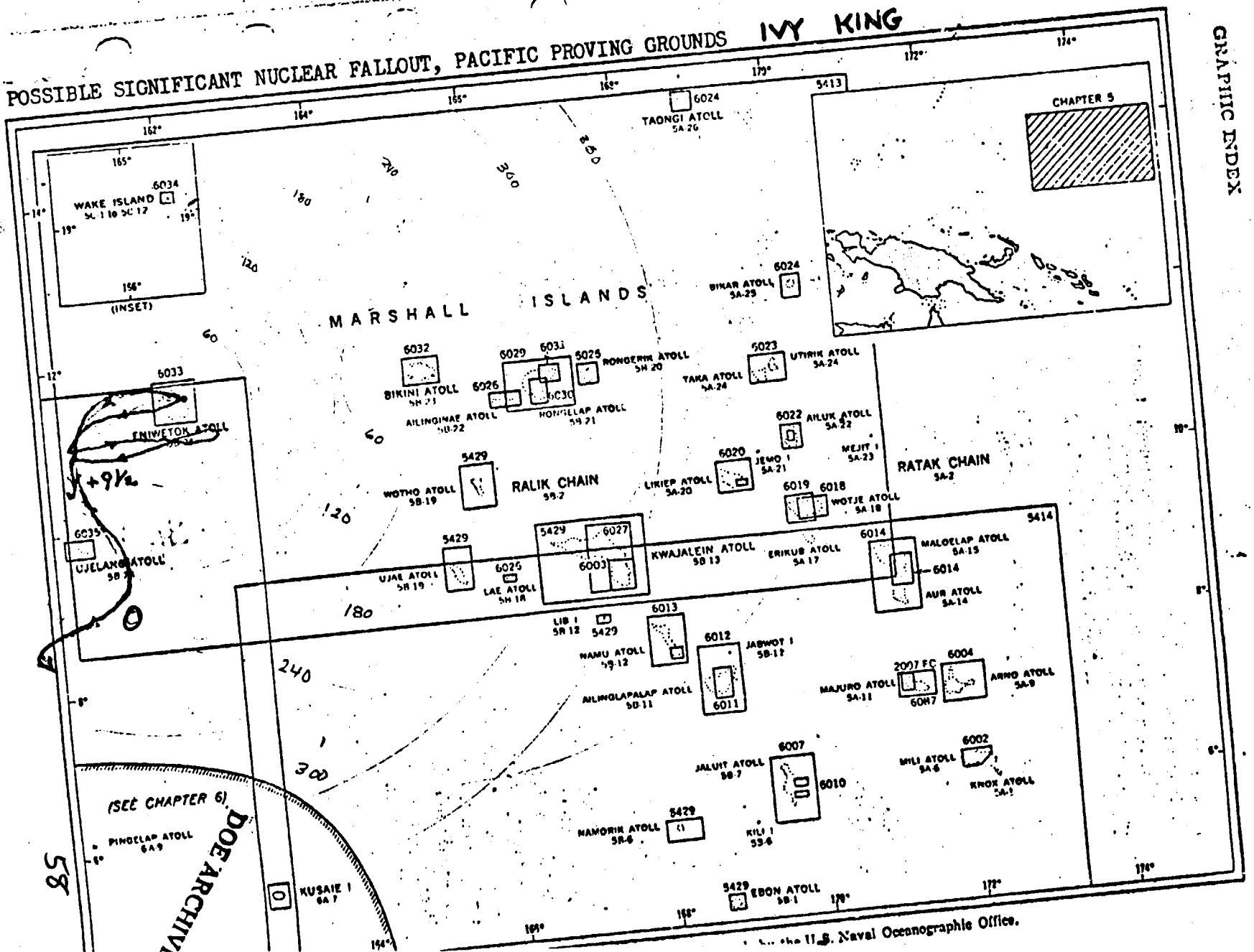

... the U.S. Naval Oceanographic Office.

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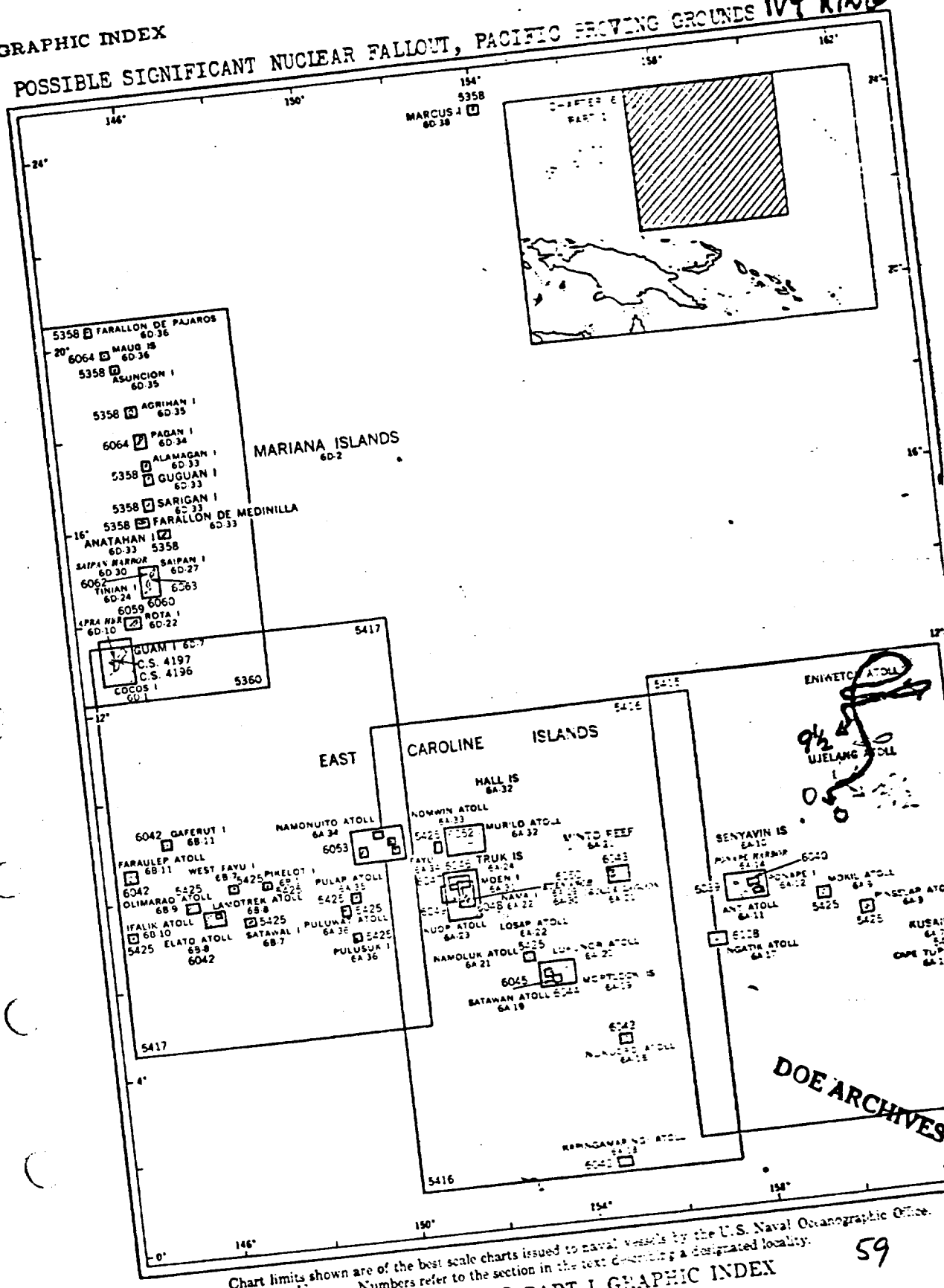

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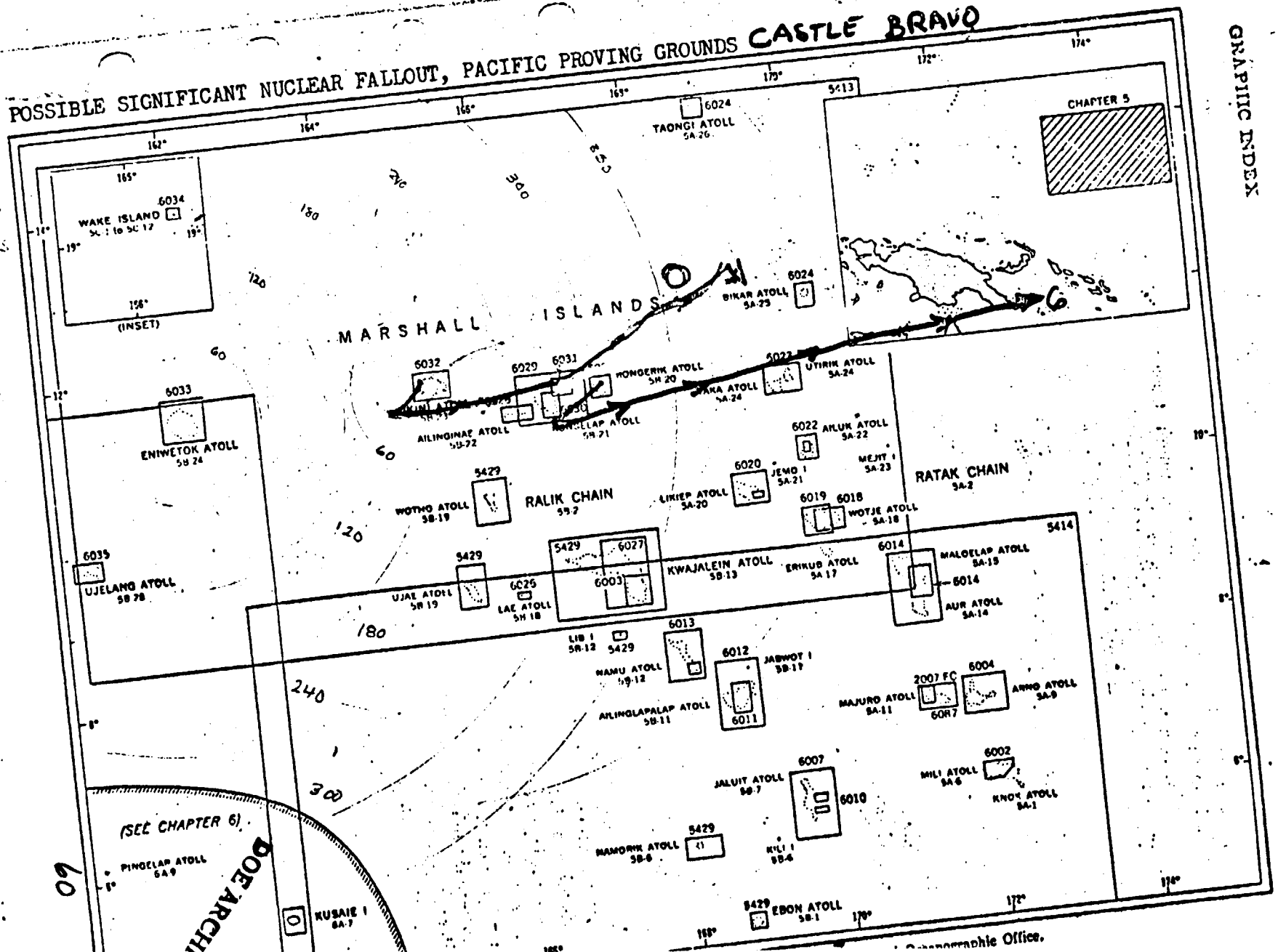
POSSIBLE SIGNIFICANT NUCLEAR FALLOUT, PACIFIC PROVING GROUNDS CASTLE BRAVO
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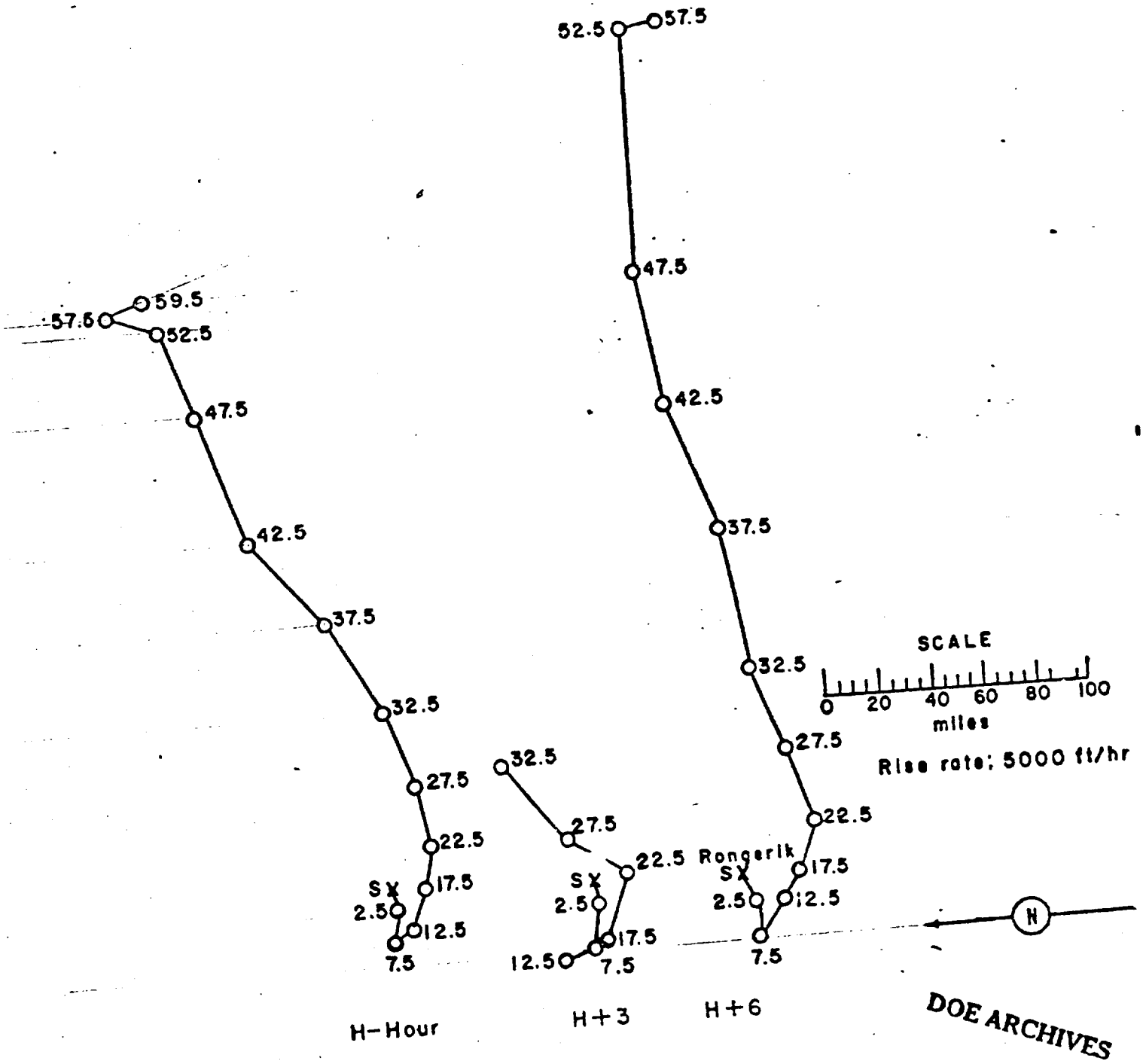
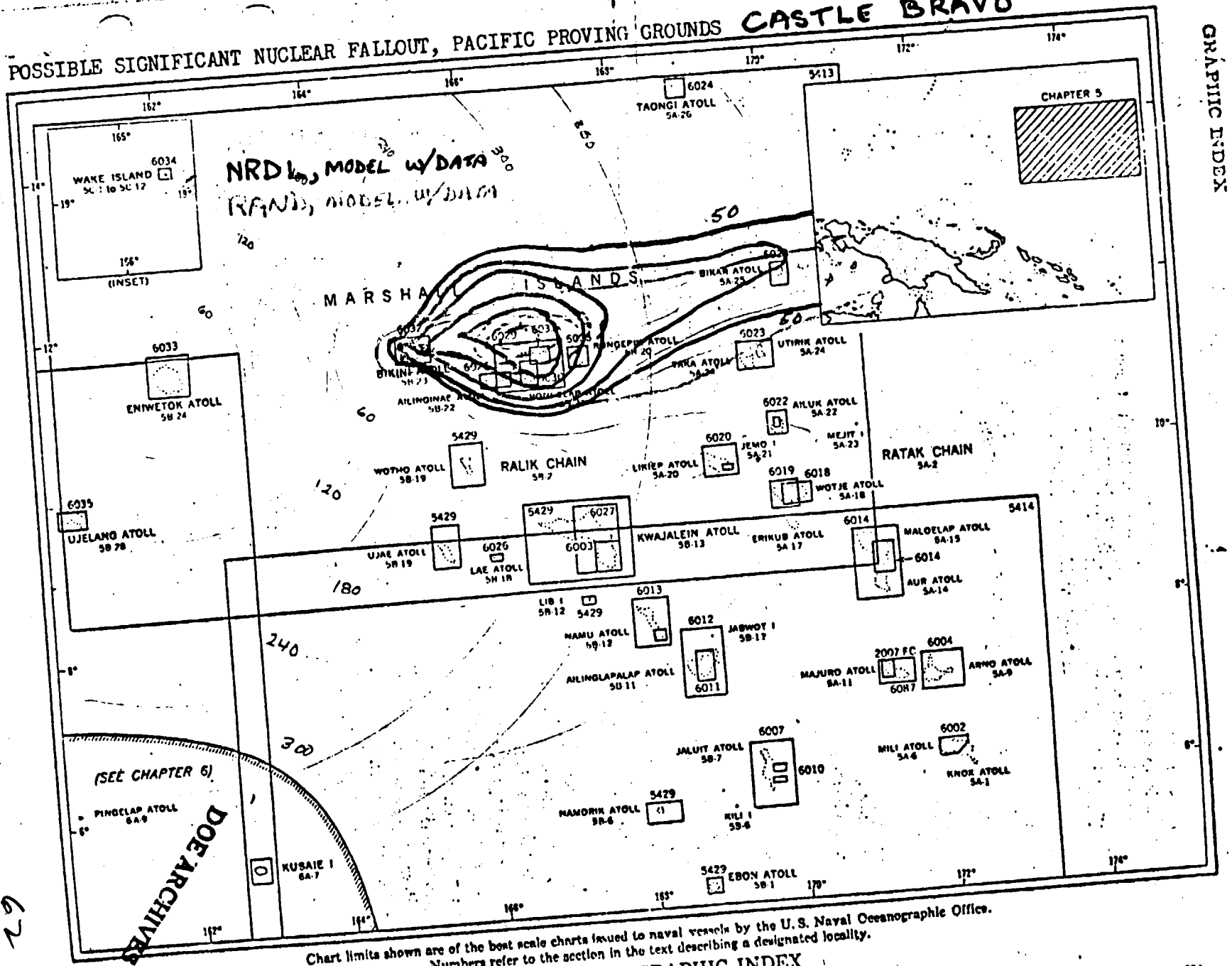
CHAPTER 5
MARSHALL ISLANDS
WAKE ISLAND
(INSET)
TAONGI ATOLL
BIKAR ATOLL
UTIRIK ATOLL
WOTHO ATOLL
RALIK CHAIN
RATAK CHAIN
ENIWETOK ATOLL
UJELANG ATOLL
KWAJALEIN ATOLL
ERIKUB ATOLL
MALOELAP ATOLL
AUR ATOLL
WOTJE ATOLL
JEMO I
AILUK ATOLL
LIKIEP ATOLL
MEJIT I
UJAE ATOLL
LAE ATOLL
LIB I
NAMU ATOLL
AILINGLAPALAP ATOLL
JABWOT I
MAJURO ATOLL
ARNO ATOLL
JALUIT ATOLL
MILI ATOLL
KNOX ATOLL
NAMORIK ATOLL
KILI I
EBON ATOLL
(SEE CHAPTER 6)
PINGELAP ATOLL
KUSAIE I
H.O. 82—Change 3



Hodographs for Operation CASTLE - Shot 1 - Bravo.

POSSIBLE SIGNIFICANT NUCLEAR FALLOUT, PACIFIC PROVING GROUNDS CASTLE BRAVO



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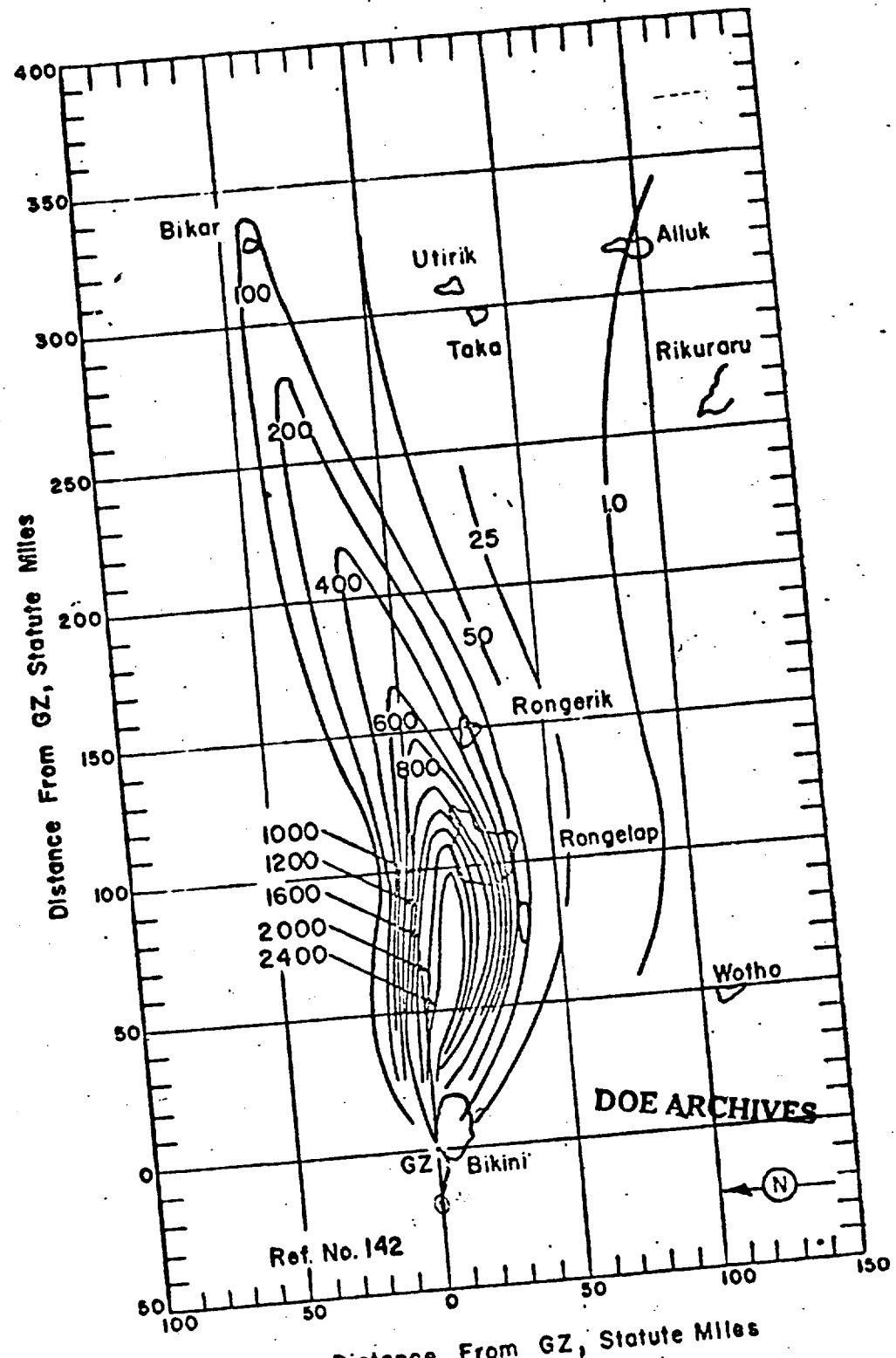
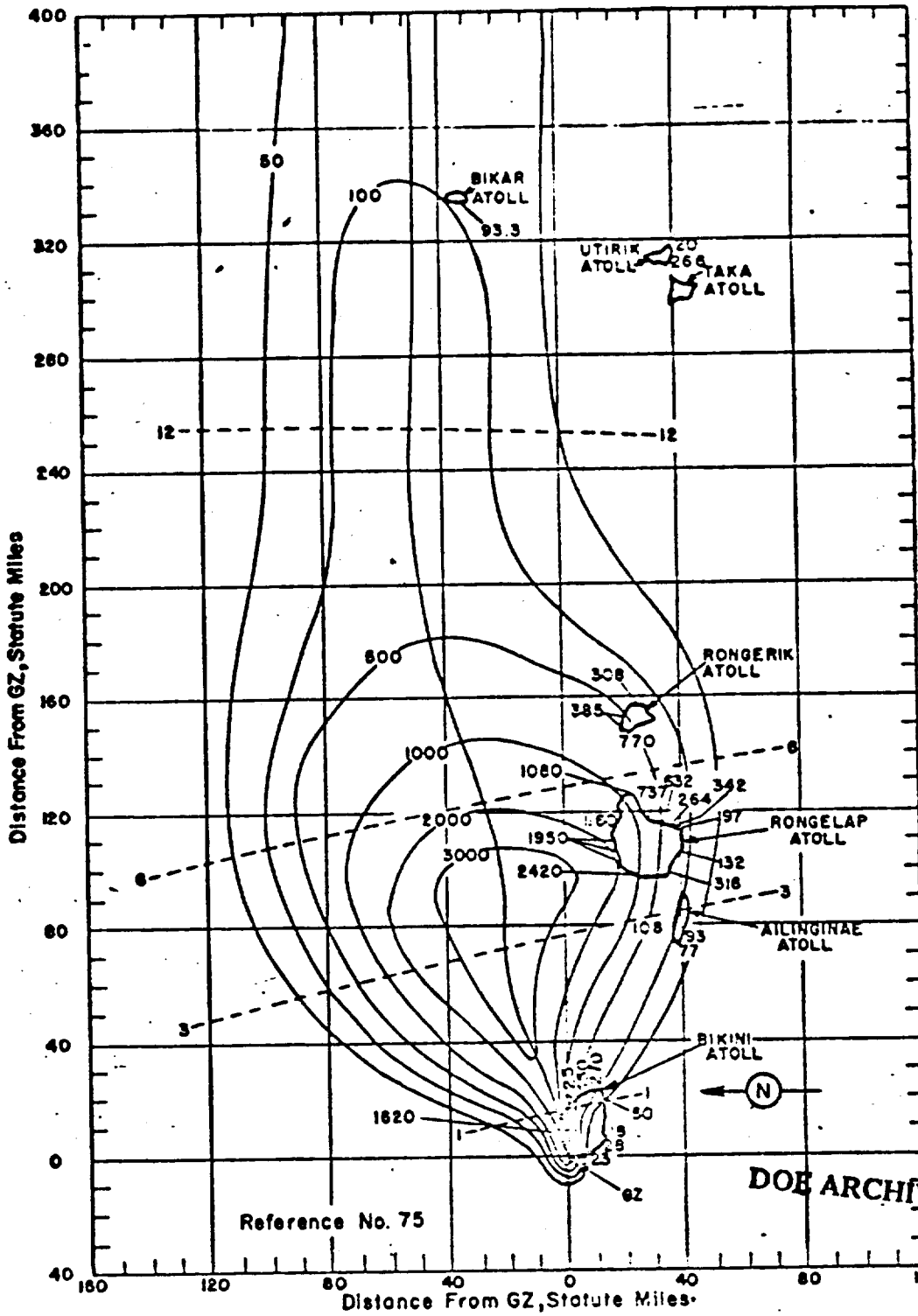
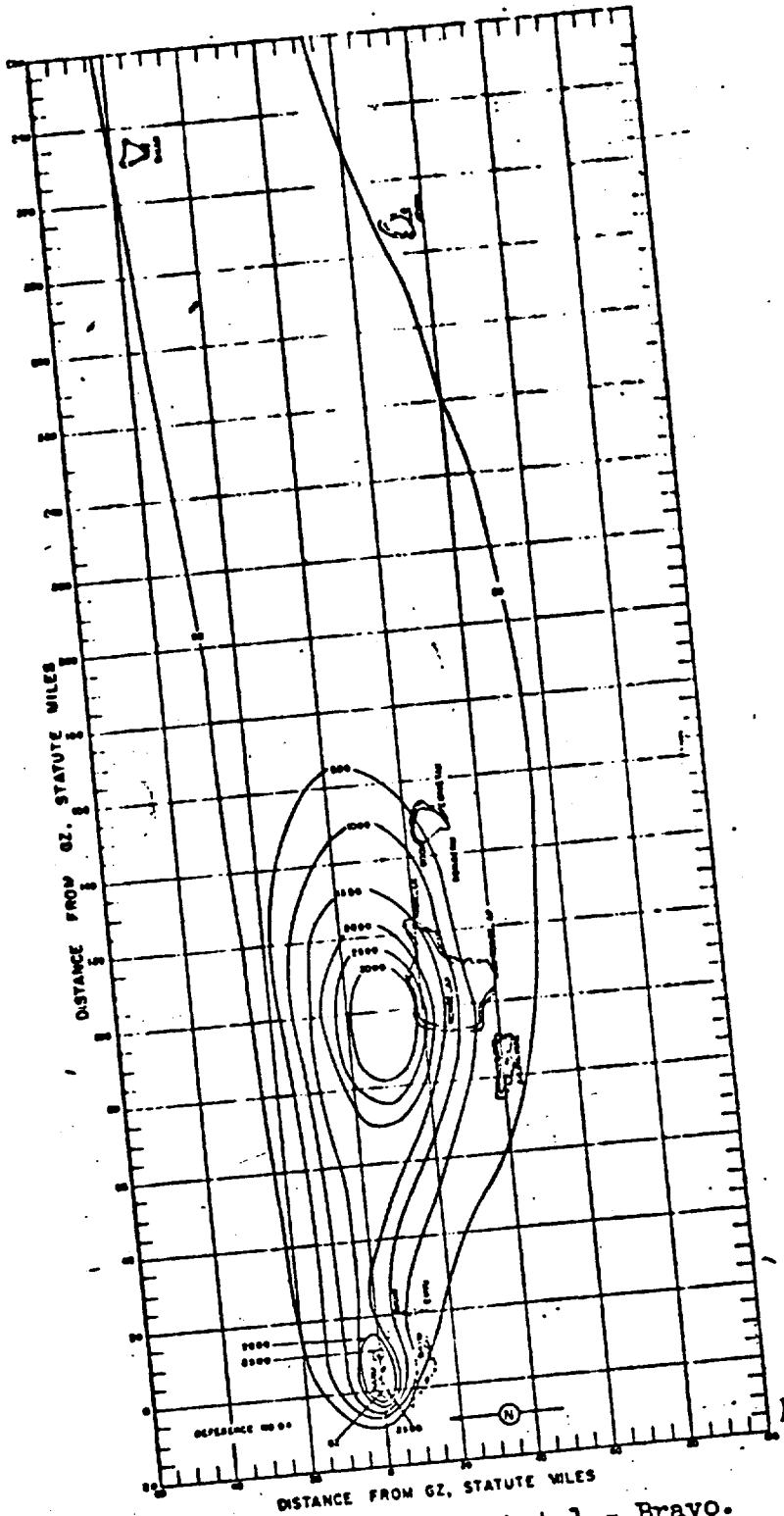


Operation CASTLE - Shot 1 - Bravo.
Off-site dose rate contours in r/hr at H+1 hour (



Operation CASTLE - Shot 1 - Bravo.
Off-site dose rate contours in r/hr at H+1 hour (NRDL).



Operation CASTLE - Shot 1 - Bravo.
Off-site dose rate contours in r/hr at H+1 hour (RA

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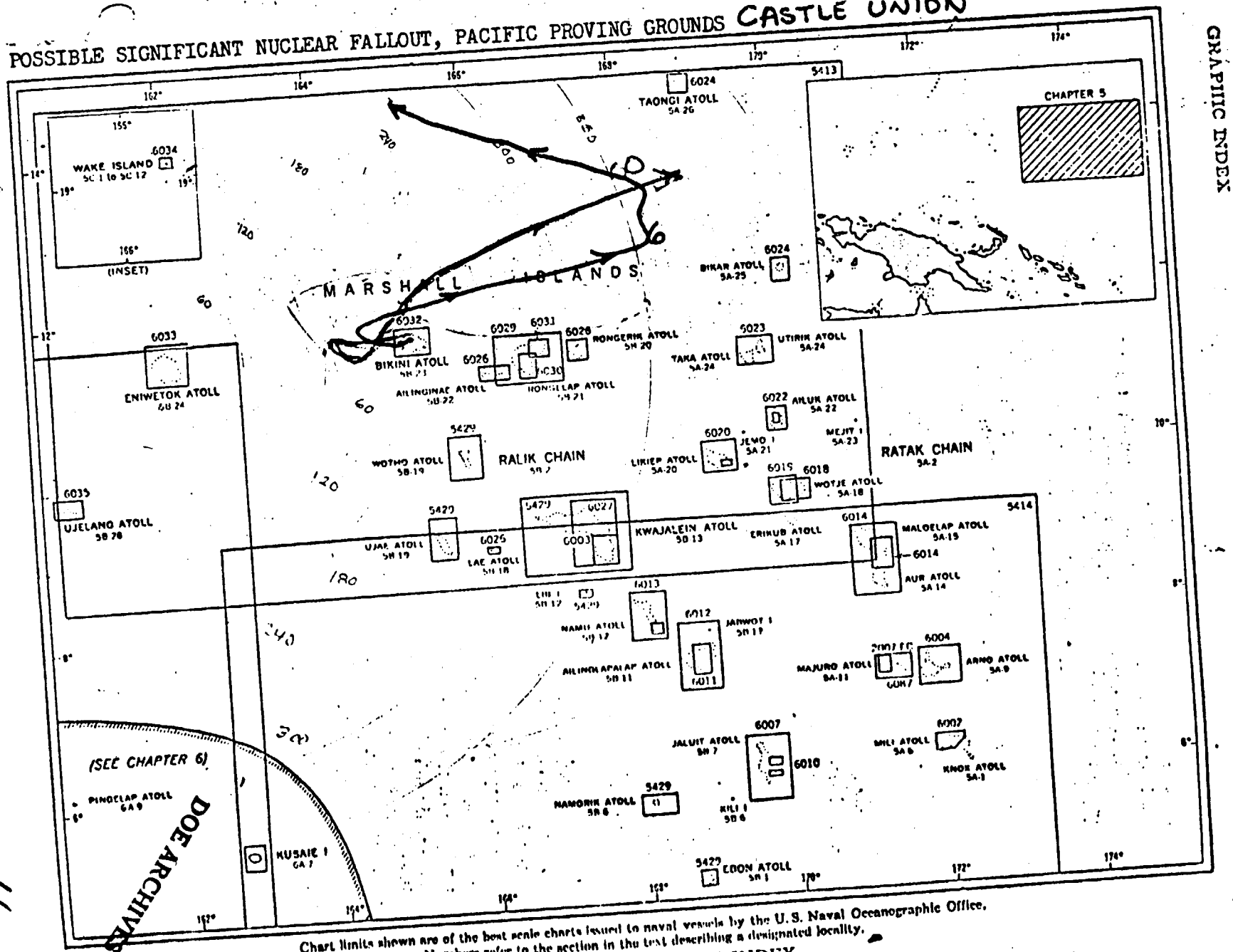
POSSIBLE SIGNIFICANT NUCLEAR FALLOUT, PACIFIC PROVING GROUNDS CASTLE UNION



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