February 5, 1985 Draft

Mr. Richard Ramirez
Astroline Communications Co.
WHCT-TV
City Place, 31st Floor
Hartford, Conn. 06103

Dear Mr. Ramirez:

As requested by Mr. Charles Perry of Moffett, Larson and Johnson P.C , we have received your tower site location on Avon Mountain, in Avon, Conn., to determine the height of the tallest guyed tower which can be built on the plot.

There are two separate conditions which must be satisfied; the first is that the maximum fall radius of the debris from the collapsing tower will not impact the ground beyond the property lines; the second being that there must be sufficient property for the minimum length guy to fall within the property line, or within the required set back lines.

We will treat the second consideration first, as it is a mathematically calculable function of the physical parameters of the structure, that is the height is limited to that which will permit a horizontal guy projection on a flat surface of 30 percent of the tower height. Steeper guys would result in

extraordinarly high cost to provide the safe stability of the tower antenna system. There are many guyed towers, where 30 to 33 percent guying has been used, which have performed well enough over a sufficient length of time to technically justify their use as TV antenna support structures, and which have proven to be economically practical.

Without consideration of set back, the height of the structure works out to be 712.4' when located as shown on the marked up copy of the plot plan. To satisfy the set back requirements, additional land would have to be purchased along the easterly border. Approximately, the new plot would have to be 70' wide. Should the land not be available the permissible tower height would have to be reduced to approximately 630', unless a variance could be obtained.

A review of properties adjacent to the plot on the easterly side, indicates that the 712.4 tower with a 62.6' antenna or 775' overall could be located in several locations, which might, due to the topograpy, also provide guys with a greater vertical angle to the tower, in effect increasing the guying ratio above the minimum 30 percent.

Having satisfied the second criteria, we must now consider the first criteria. Were the 775' tower antenna structure to collapse, would the debris fall on adjacent property? The answer is, no -

it would not. This answer is based on thorough on going research over the last 30 years covering collapses dating back 40 years, as well as the experience gained in maintaining, construction and engineering broadcast tower antennas since July of 1952. A short summary of the reasoning on which the answer is predicated is as follows:

1. There are two types of tower, free standing on self supporting types, and guyed types.
2. Self supporting towers depend on the cantelevered trussaction resisted at the base by large foundations. If the structure fails at the base, it can topple, that is fall like a felled tree, and thus impact the ground a distance equal to its full length from the base. The topple can occur only in the directions perpendicular to the faces of the tower. The existing tower could impact the ground in any one of four directions, a distance 350' from the base. Though this is rare occurence for self supporting towers, it is quite common with poles or masts, and resulted in zoning laws calling for a 1 to 1 ratio between height and set back.
3. Guyed towers cannot topple. This is due to the fact that it would require the simultaneous failure of all the guys on one line, with out any tower member buckling, a circumstance attainable only by controlled explosive severing of the guys.

The restricted fall radius in collapsing towers is principally due initially to the gravity induced inertial characteristic of the guys to fall straight down, which is reinforced as the falling guys gain momentum during the fall. When the upper guy fails the top span tends to topple, however, as there is no ground to impact it continues swinging in and impacts the lower sections of the tower. At this point anything can happen, as there is a tremendous degree of interaction, and all thoughts of predictability vanish.

When a lower guy fails the upper portion separates from the lower portion at the guy point. The upper portion tends to fall straight down being guided by the intact guys, the lower portion tends to topple out and impact the ground, again the interreactions preclude any possibility of prediction.

While we cannot predict the specific collapse sequence, or sometimes cannot even recreate it based on the debris pattern, we can by studying the debris pattern of tower collapses develope a pepipheral pattern within which the debris can be expected to be contained.

We have surveyed layouts of the debris patterns from seven tower collapses with which we were professionally involved. In addition we have been given verbal descriptions, by other engineers and reviewed photographs for 20 or 30 additional

collapses. From this data we have developed an area pattern within which all the debris, from all the collapses, has impacted the ground. This covers towers from 400' to 1860' high.

All of the debris from a standard multiguyed tower, with or without a top antenna would impact the ground within a circle with a radius which would not exceed 29 percent of the tower height. The actual pattern looks much like a six spoked cog wheel. The center hub having a radius of 20.6% of the tower height, within which 95% of the debris is generally located, and six spokes approximately 10% of the tower height in width having an outer radius of 29% of the tower height. The remaining 5% of the debris will fall in one or more of these spokes. The height of the tower being 712.4' the hub radius will be 147' and the spoke radius will be 207'. Where, as in this case the outer spoke radius lies completely inside the property lines the simple circular perimeter could be considered instead of the spoked wheel perimeter. The minimum clearance using the circle is 5' on both the east and west property lines (2 locations), using the spoked wheel the minimum clearance is 14', at 4 locations two each on the east and west property lines.

A review of the surveyed plots will show that the only tower which reached 29% was a Loran "C" tower which had heavy insulators in the guys. The proposed tower does not have guy insulators.

Therefore, the chance of guy failure is reduced to almost zero. The anticipated maximum fall radius is actually 24% or 171', which increases the minimum clearance from 14' to 50'. Therefore, the chance of any tower debris impacting outside the property line is extremely remote. However, it is our opinion that it is far better to insure that the tower does not collapse, by having the tower properly designed, fabricated, installed and maintained.

Proper design includes not only correct technique, but also, correct judgement as to the amount of wind for which the tower is designed, and also to account for special conditions at the given site of which "ice" is the principal example. Omission of the latter is responsible for almost ninety percent of all tower failures. Proper fabrication speaks for itself, and is a prerequisite for the tower to perform as it was designed. There are two or three firms we consider qualified to design and fabricate tall towers. If suitable wind and ice loading conditions are specified by the owner, through his consultant, it is our opinion that any of the three firms could design and fabricate a tower which would be completly safe.

Proper construction will be required to insure that the installed components function in the manner for which they were designed, and proper maintenance to insure that the tower components retain the capacity they had when installed. This can be achieved by

having a firm such as ours provide consultation during and on completion of the tower installation and by scheduling annual inspections by a tower maintenance company augmented by tri-annual inspections by a company such as ours.

Providing proper design, construction and maintenance conditions are met it is our opionion that the proposed WHTC tower would be totally safe.

The data included in this report is based on our thirty-three years of professional involvement in the broadcast tower antenna field, both in construction and maintenance (1952-1974), and in engineering and consulting (1971-1985). A summary of this experience along with our educational background is included in the attached resume. We are generally recognized as one of the foremost authorities in the structural end of broadcast tower antenna industry.

Should you have any questions pertaining to this report please do not hesitate to contact us.

Sincerely yours,
GUNNAR OLSEN, JR., P.A.

Gunnar A. Olsen, P.E.

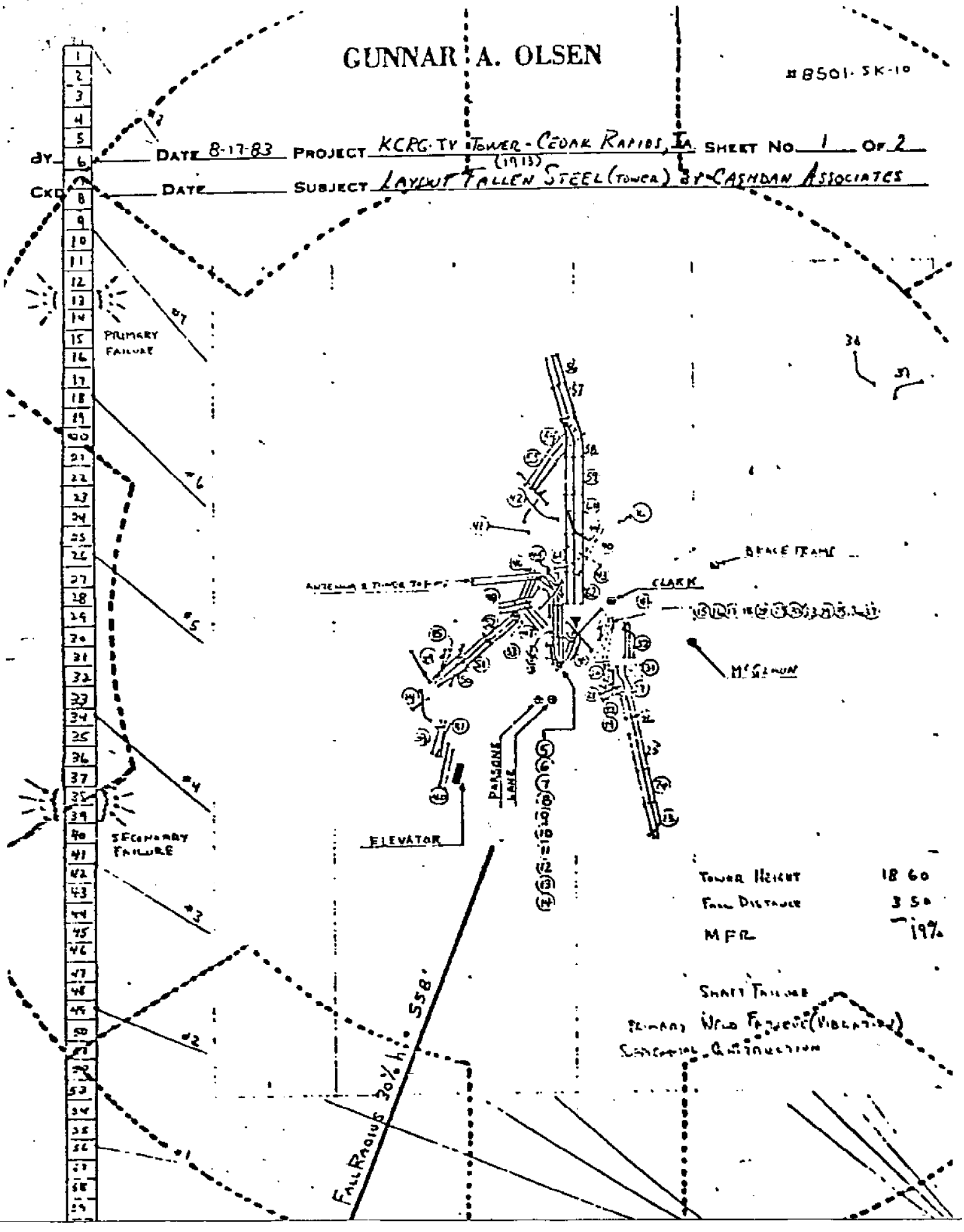
GAO/jcm
Enclosure

GUNNAR A. OLSEN

#8501-SK-10

BY _____ DATE 8-17-83 PROJECT KCRG-TV TOWER - CEDAR RAPIDS, IA. SHEET NO 1 OF 2

CKD _____ DATE _____ SUBJECT LAYOUT FALLEN STEEL (TOWER) BY CASHDAN ASSOCIATES (1913)

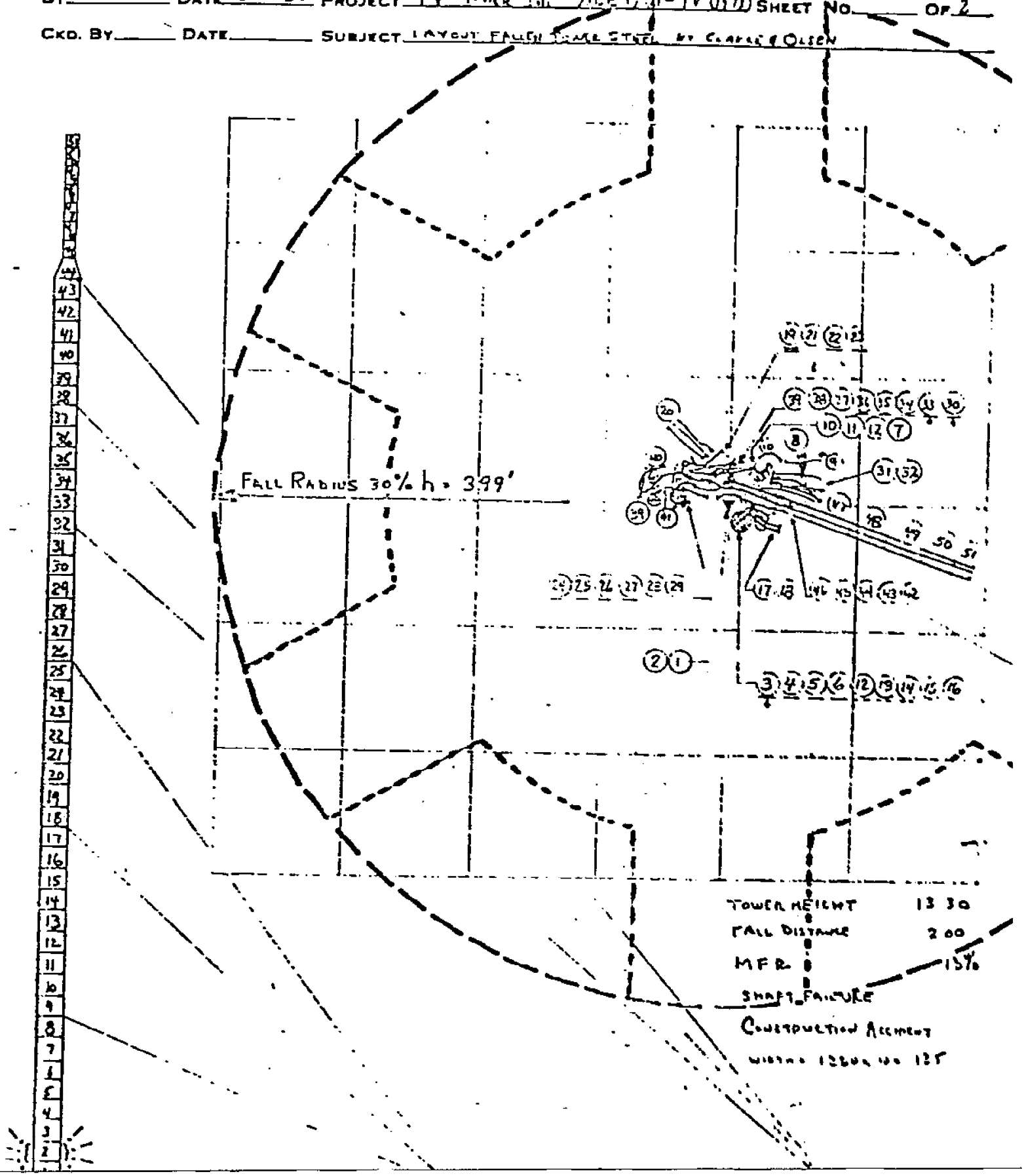


GUNNAR A. OLSEN

#8501-SK-11

BY _____ DATE 8-17-85 PROJECT TV Tower Tur [illegible] TV (171) SHEET NO. ____ OF 2

CKD. BY _____ DATE _____ SUBJECT LAYOUT FALLEN TOWER STEEL BY CHARLES OLSEN



GUNNAR A. OLSEN

A8501 SK-12

BY _____ DATE 8-11-83 PROJECT IWO-JIMA = U.S.C.G LORAN C TOWER (1964) SHEET NO. 1 OF 2

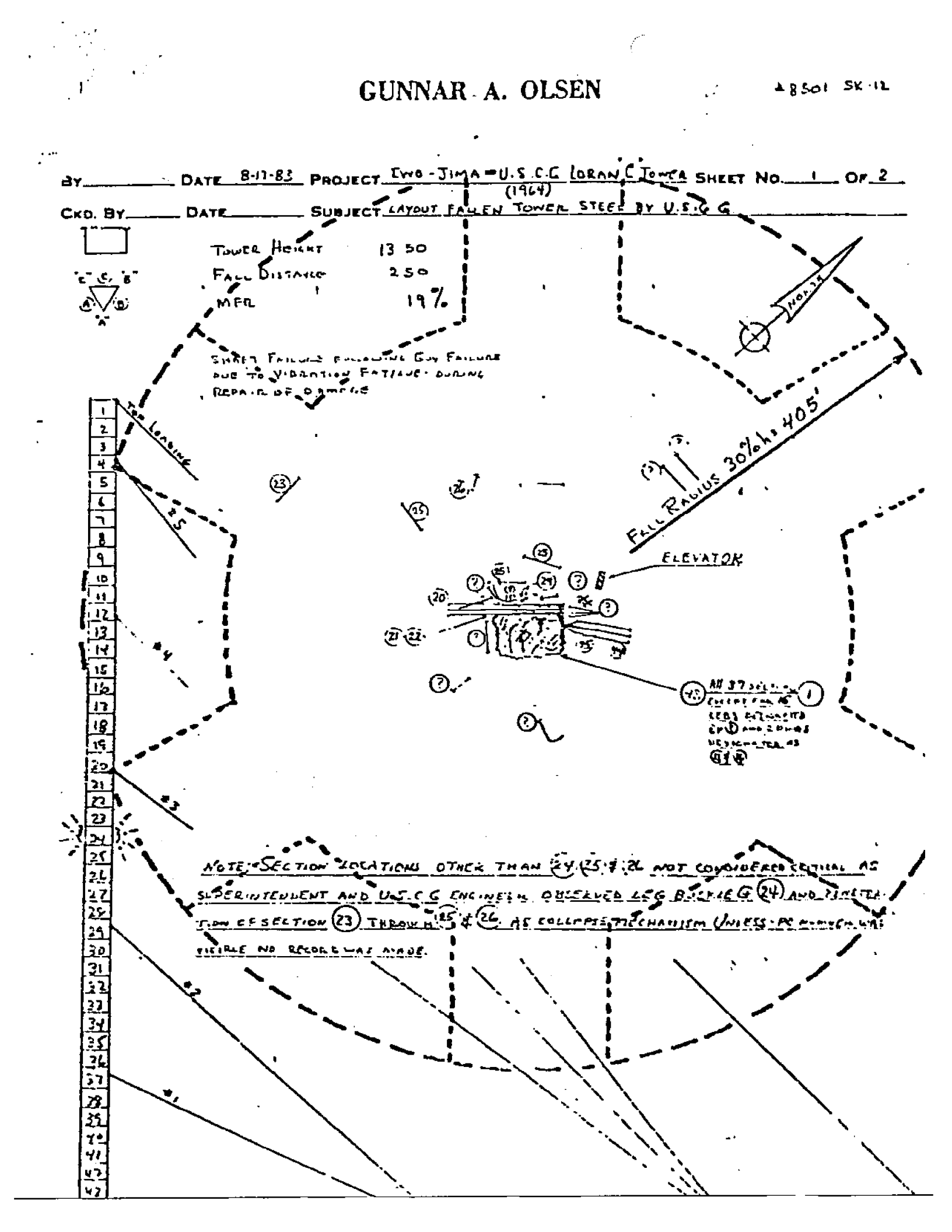
CKD. BY _____ DATE _____ SUBJECT LAYOUT FALLEN TOWER STEEL BY U.S.C.G

Tower Height 1350

Fall Distance 250

MFR 19%

Sheet Failure following Guy Failure due to Vibration Fatigue during Repair of Damage



GUNNAR A. OLSEN

#8501 SK-13

BY _____ DATE 8-11-82 PROJECT GREENLAND I.S.C.C. LORAN "C" TOWER (1964) SHEET NO. 1 OF 2

CKD. BY _____ DATE _____ SUBJECT LORAN "C" TOWER FAILURE BY U.S.C.G.

NOTE: SCALE & GRID 1" = 100', (5) DENOTES SECTION OR LEG, (5') DENOTES SECTION OR LEG BUCKLED UNDER ANOTHER

Tower Height 1350'
Fall Dist 370
MFR 29%

Guy Failure
HFLA Vibration Fatigue

TOP LOADING
#5
BUCKLE FAILURE
#4
SUPPLEMENTARY BUCKLE FAILURE
#3
FALL RADIUS 30% h = 405'
#2
#1

TRANSMITTER BUILDING

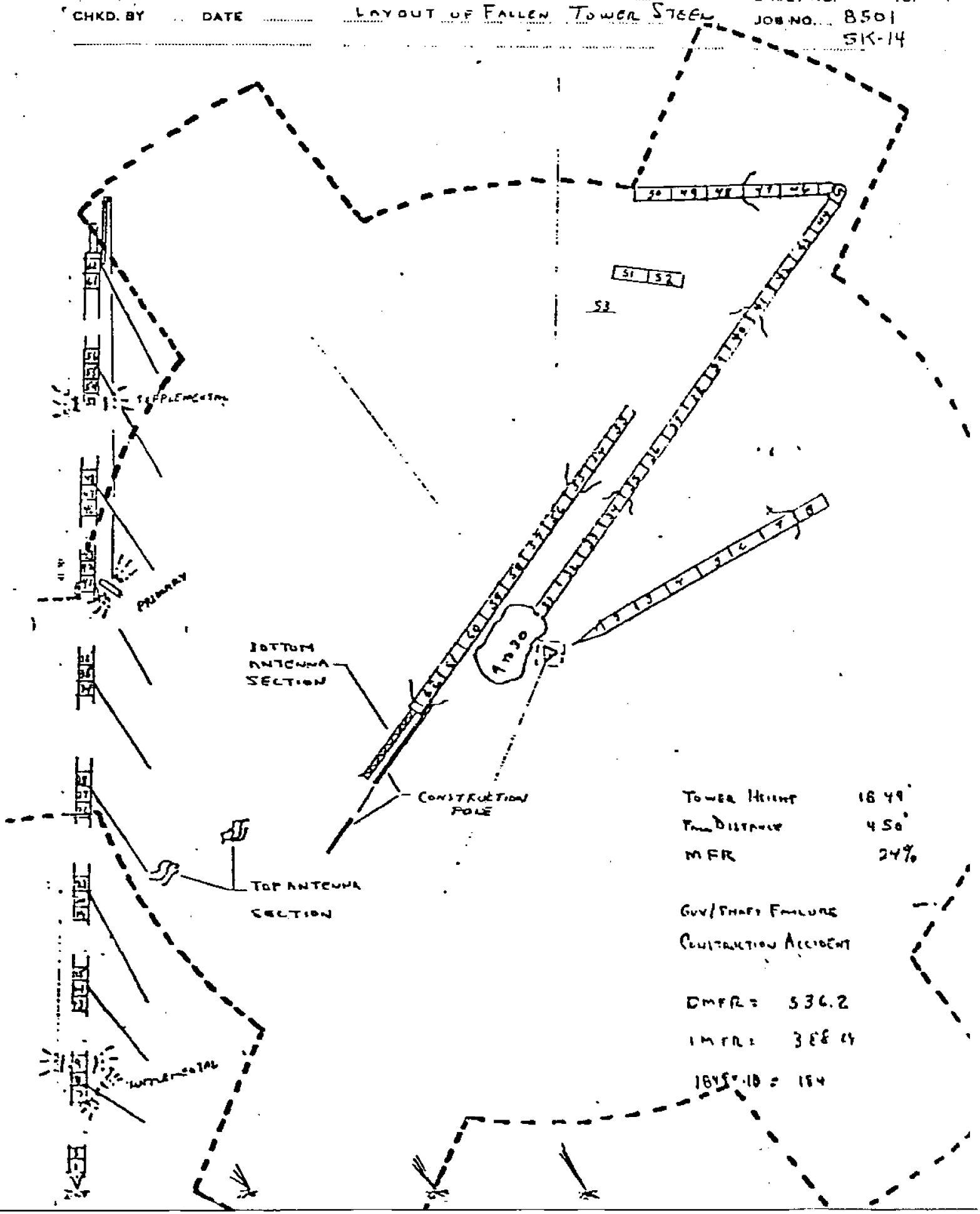
BY ... DATE 1-83 SUBJECT S.R. I.G. HOUSTON

CHKD. BY ... DATE ... LAYOUT OF FALLEN TOWER STEEL

SHEET NO. 1 OF 1

JOB NO. B501

SK-14



TOWER HEIGHT	1849'
FALL DISTANCE	450'
MFR	24%

GUY/THIEF FAILURE

CONSTRUCTION ACCIDENT

DMFR = 536.2

IMFR = 388.4

1849'-18' = 184

BY G.O. DATE 5-10-83 SUBJECT Capital Cities Cable-Pompa, Fla SHEET NO. OF

CHKD. BY DATE Layout Fallen Tower Steps JOB NO. B501

400' Microwave (tubular tower) 3K-15

OMFR = .29 x 400 = 116'

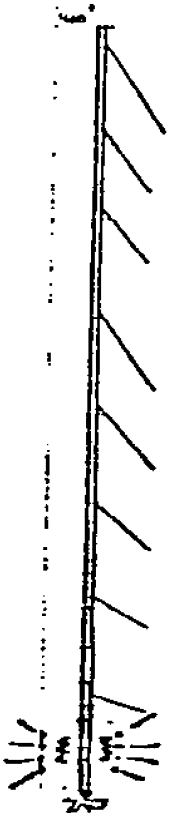
IMFR = .21 x 400 = 84'

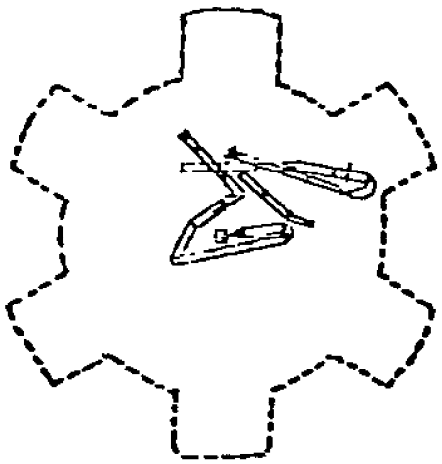
Tower Height = 400

Fall Distance = 83'

MFR = 21% (20.

SHAFT FAILURE
ICE STORM
DESIGN ERROR





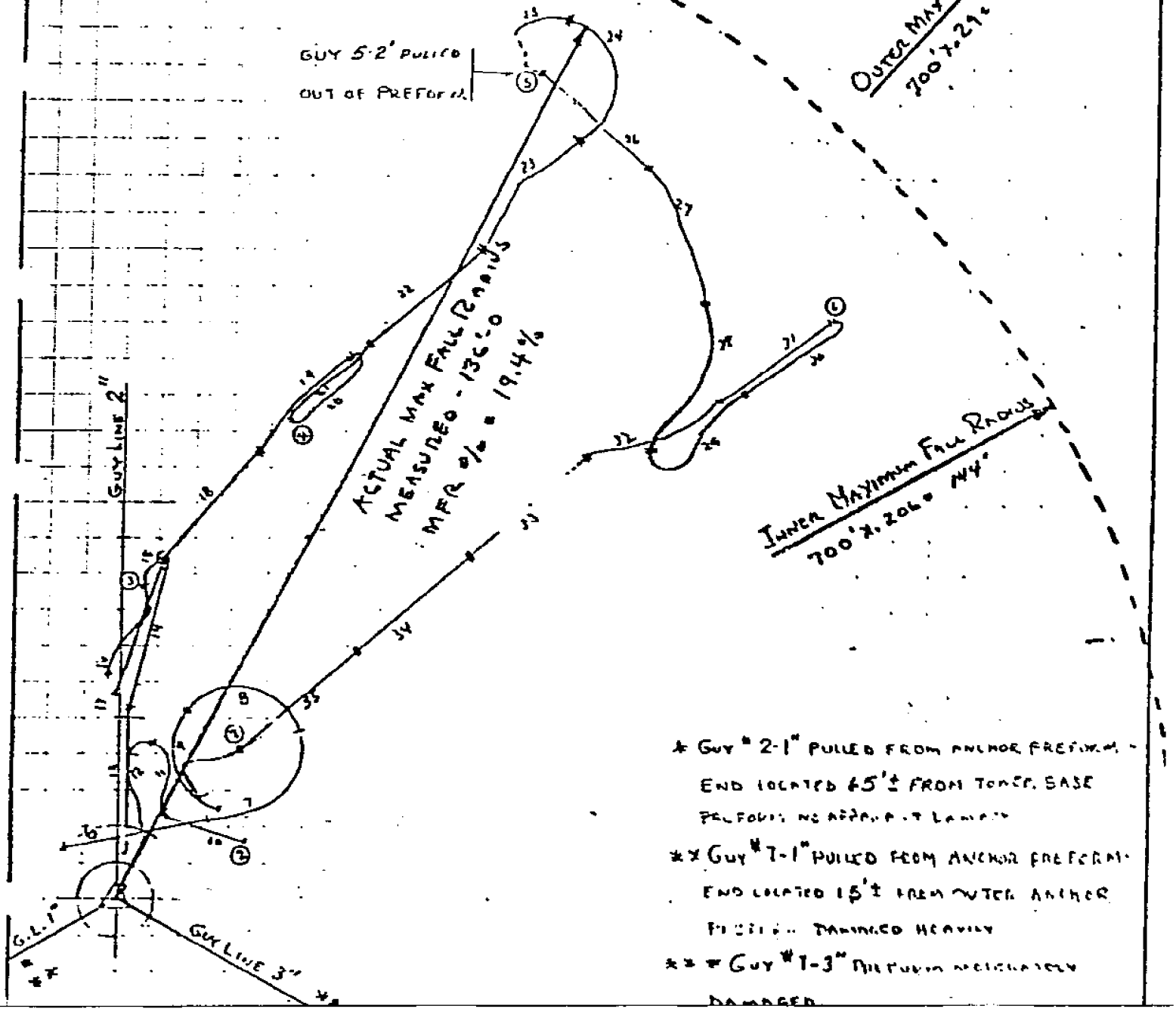
GUNNAR OLSEN JR. P.A.
Consulting Engineer
MOORESTOWN, NEW JERSEY

JOB WVII IV BANGOR, MAINE
SHEET NO 8501 SK-16 OF
CALCULATED BY G.O. DATE 2-5-85
CHECKED BY DATE
SCALE 1" = 20'-0

LAYOUT COLLAPSED TOWER DEBRIS
BLACK CAP MOUNTAIN-EDDINGTON, MAINE

OMFR = 29% (TH) 203'
IMFR = 20% (TH) 144.2'

NOTES:
1. UNLESS NOTED ALL GUYS CONNECTED AT BOTH ENDS.
2. LINE INDICATES ℄ OF TOWER SECTIONS
3. GUY LINES OMITTED FOR CLARITY AND ARE NOT SIGNIFICANT.



BY ... DATE 6/1/83 SUBJECT CAPITOL BROADCASTING

CHKD. BY ... DATE ... SEQUENTIAL COLLAPSE RECONSTRUCTION

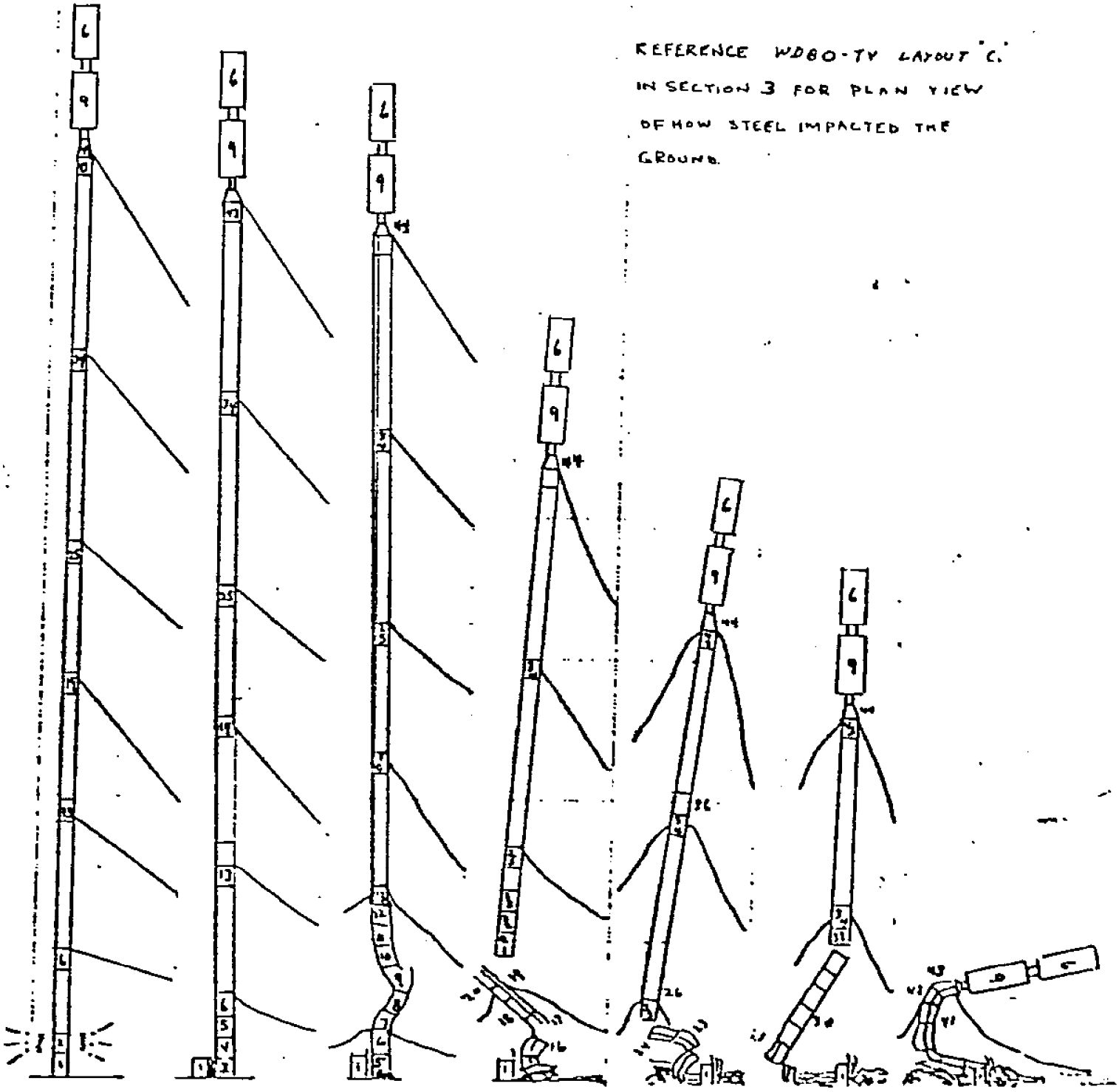
WDBO-TV 1500' TOWER ANTENNA

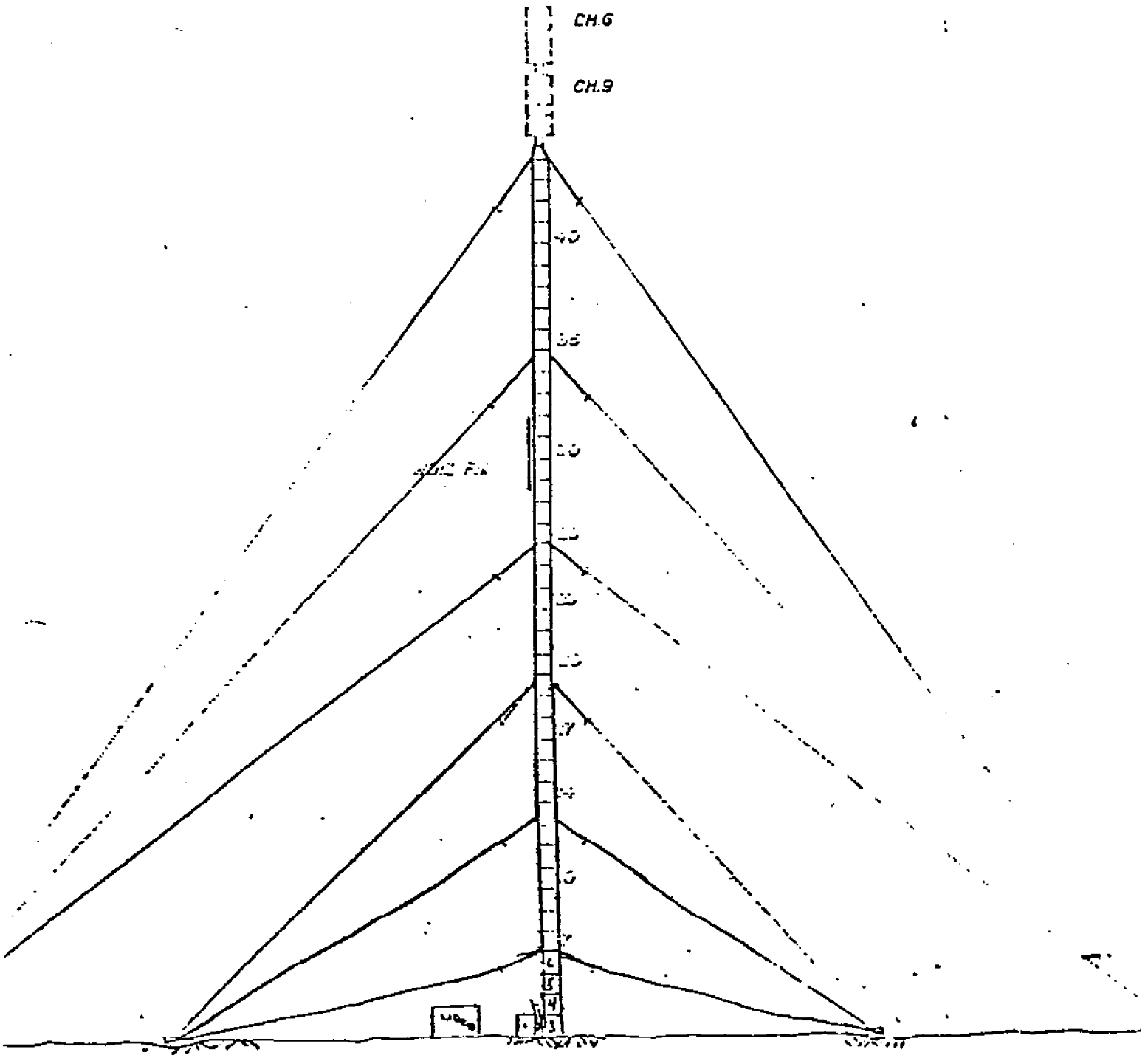
SHEET NO. ... OF

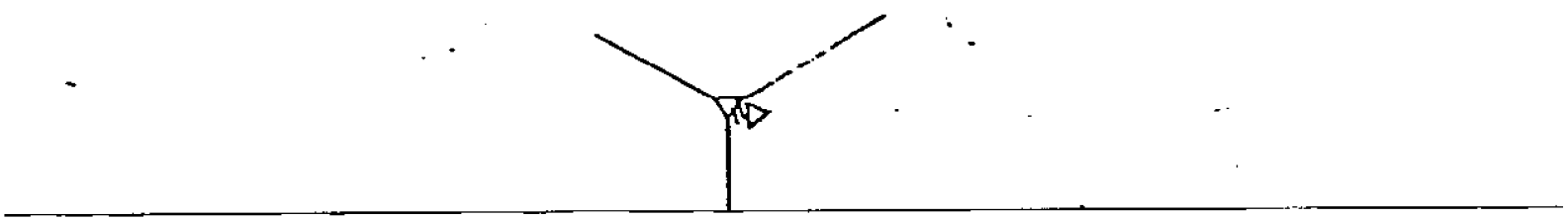
JOB NO. 8325

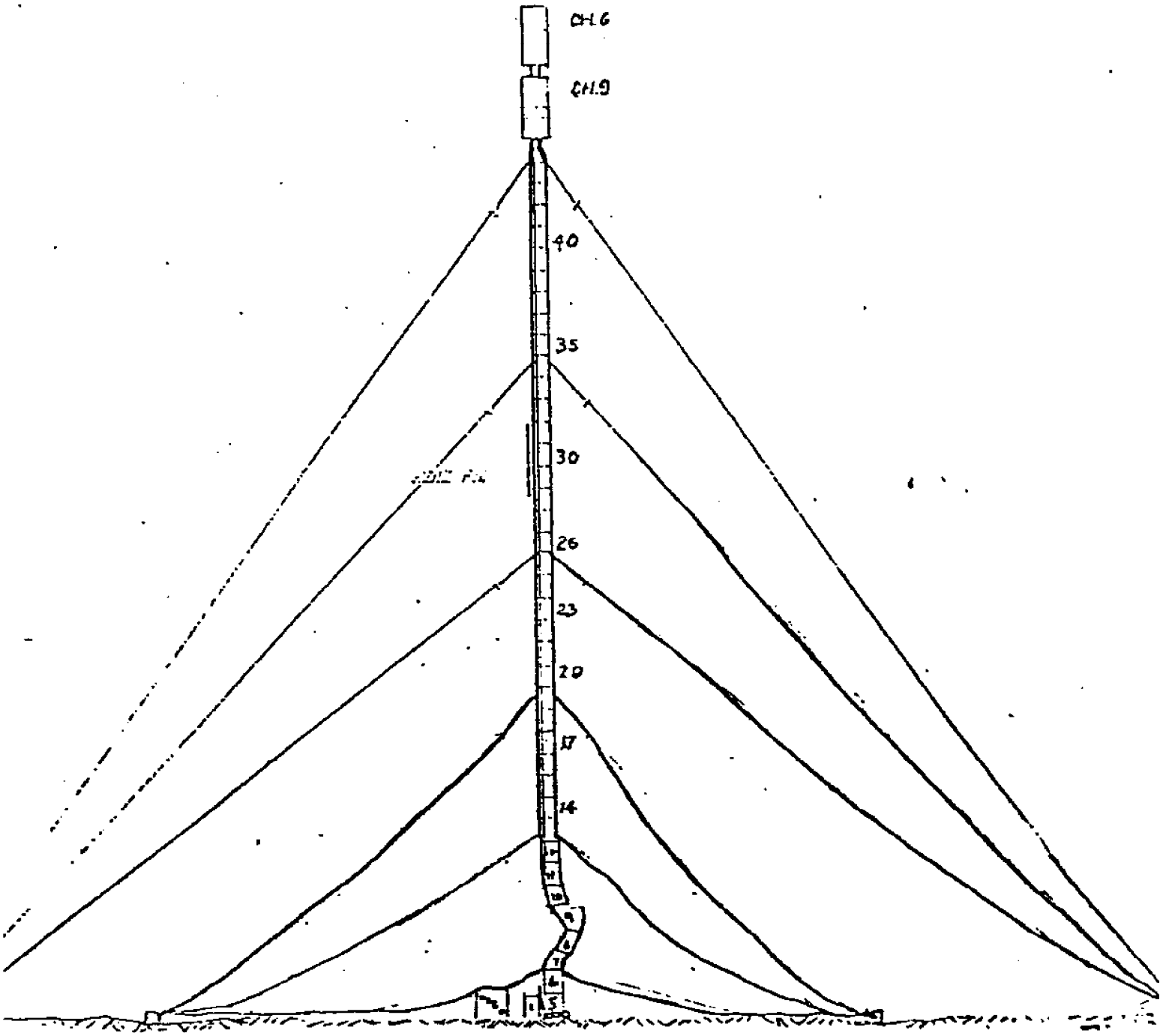
SK-1

REFERENCE WDBO-TV LAYOUT 'C' IN SECTION 3 FOR PLAN VIEW OF HOW STEEL IMPACTED THE GROUND.




CH.6
CH.9

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CH.9
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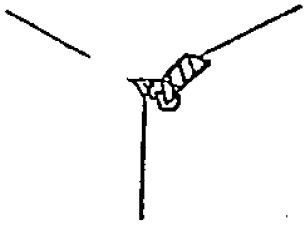

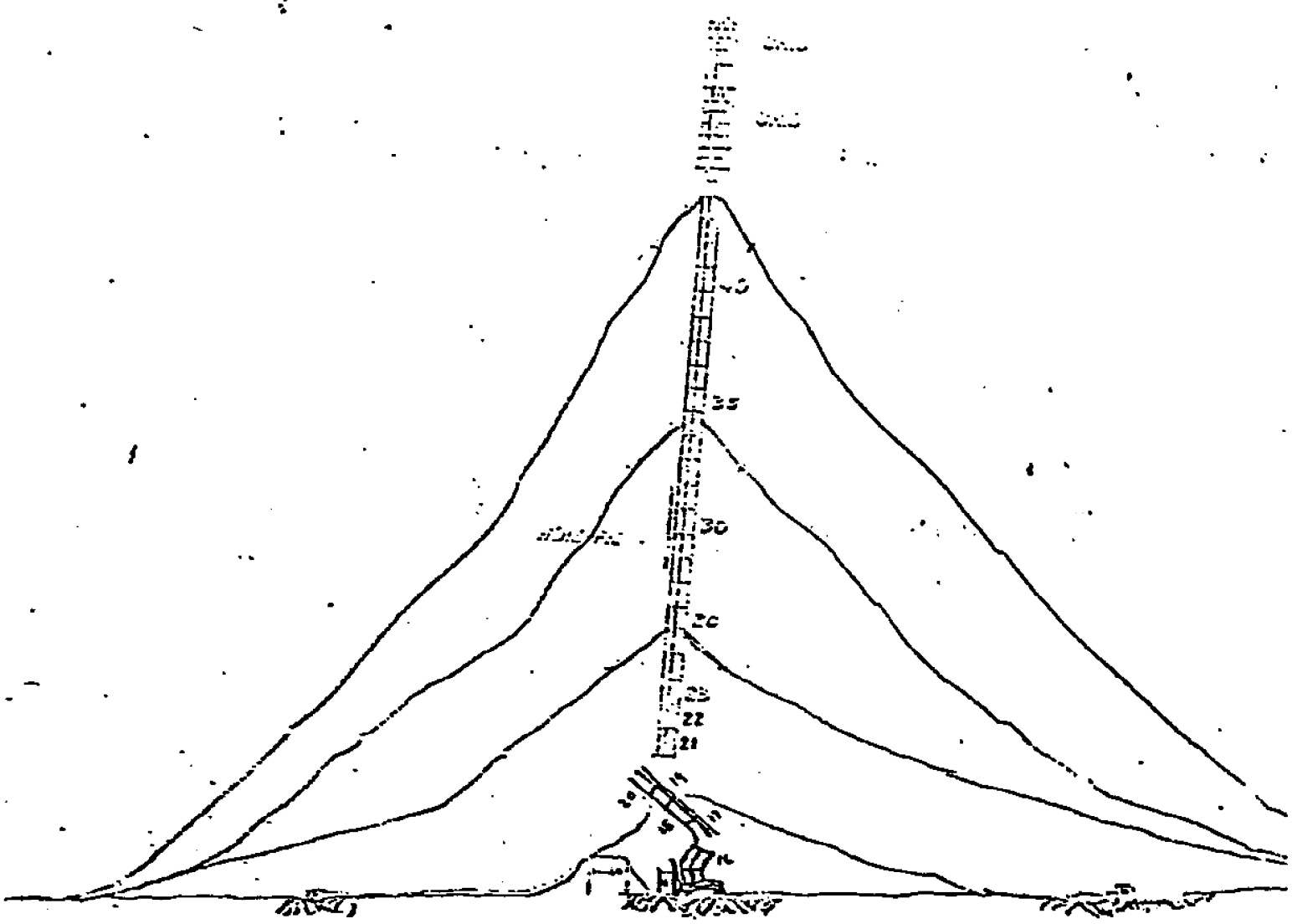
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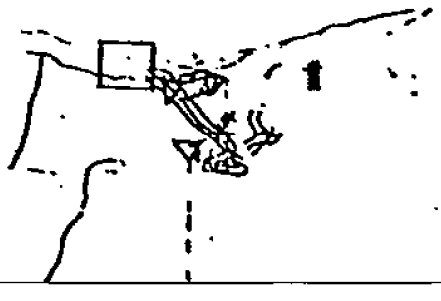

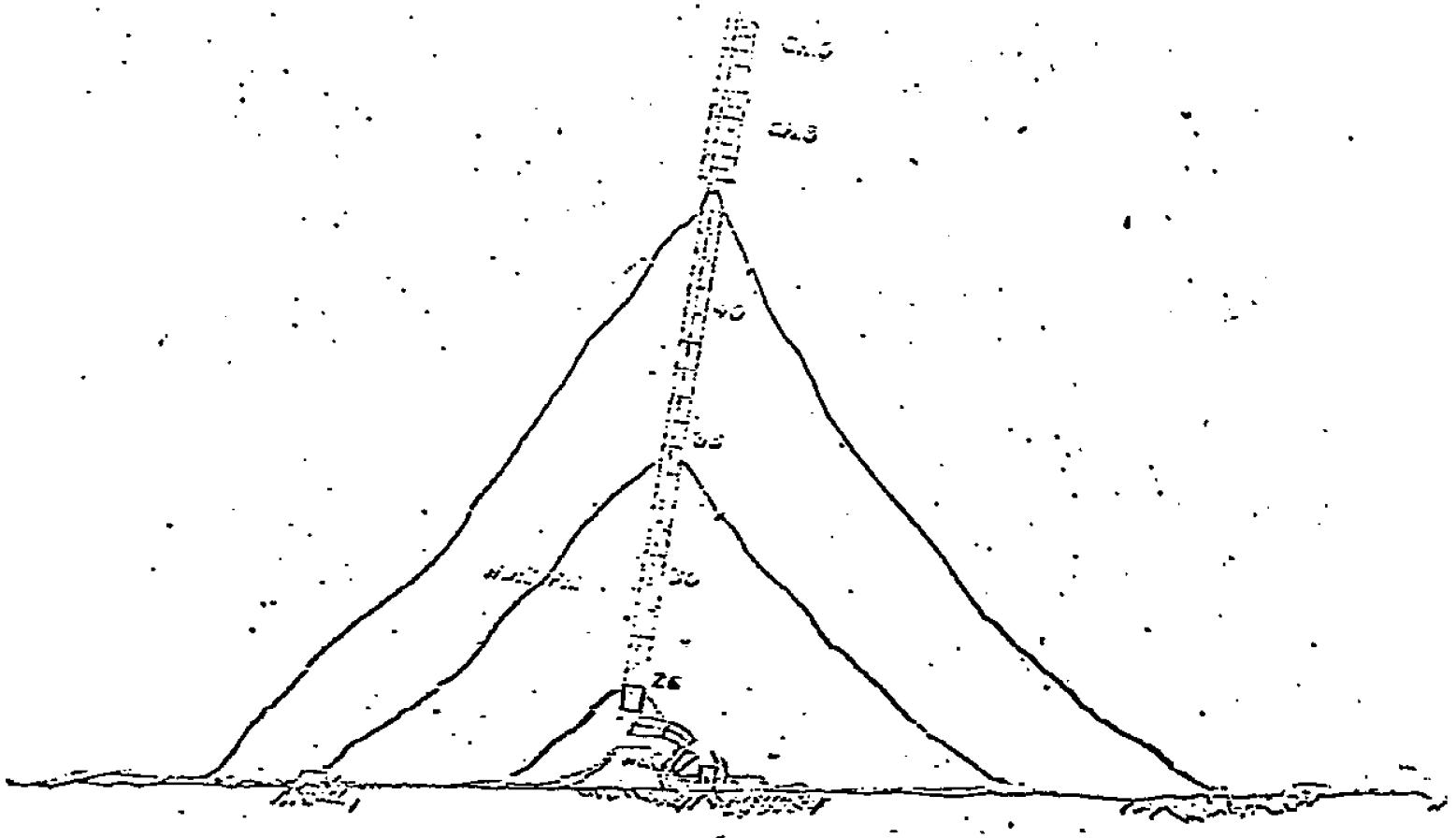

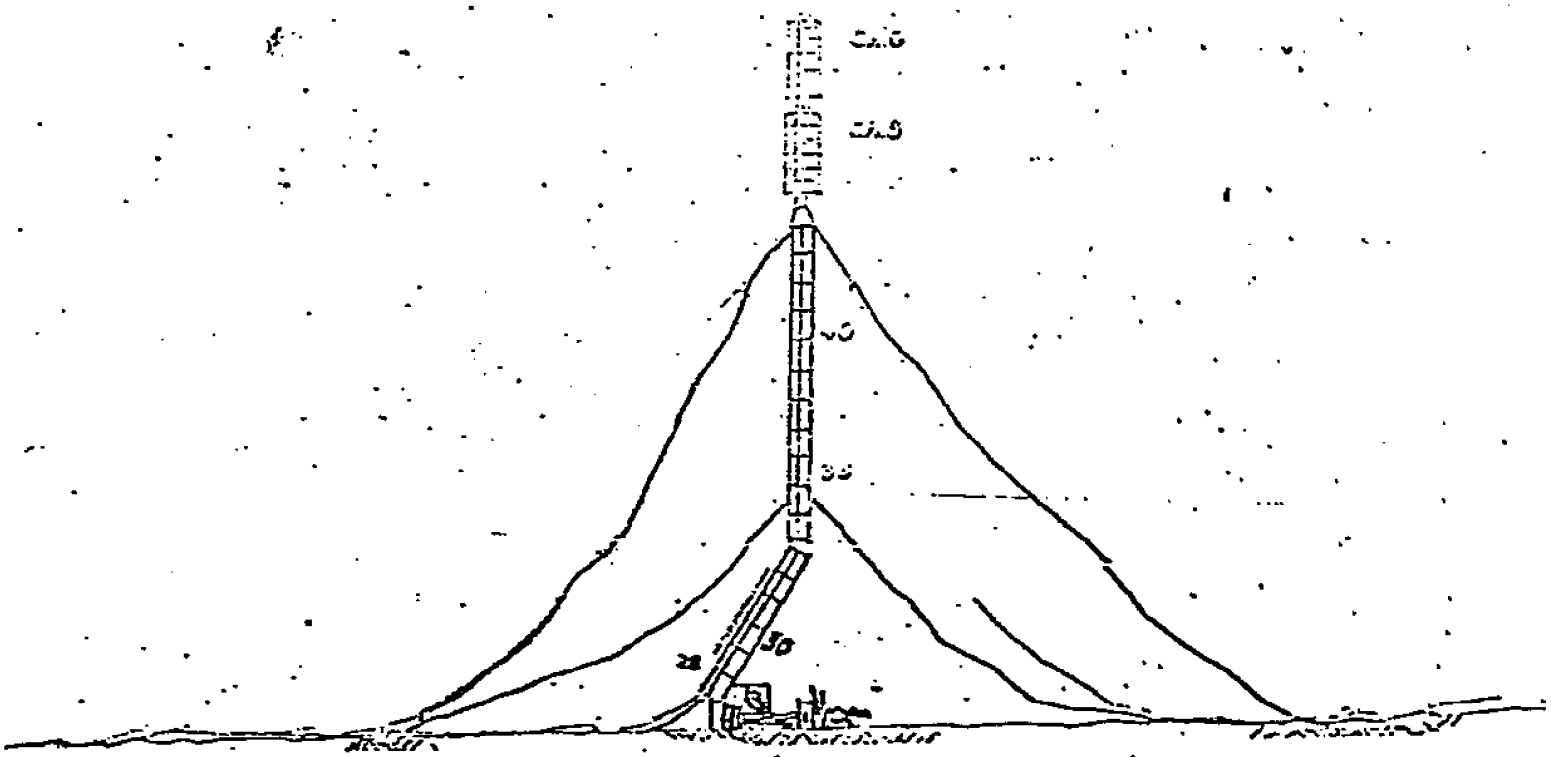

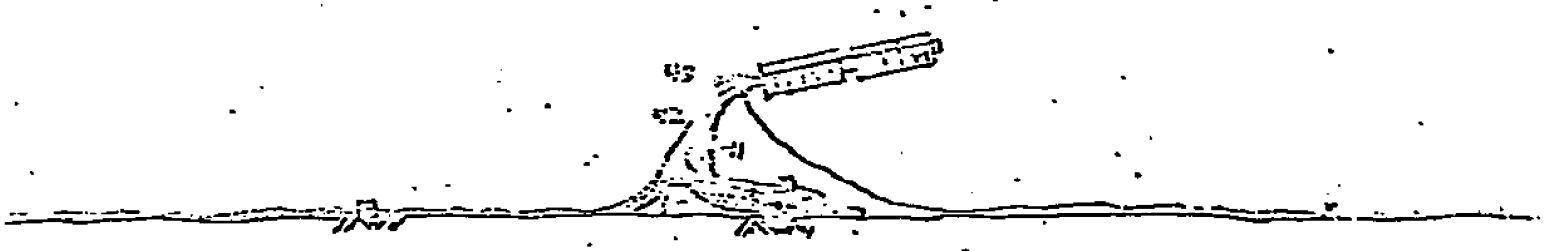

WD 80 · C.S-7