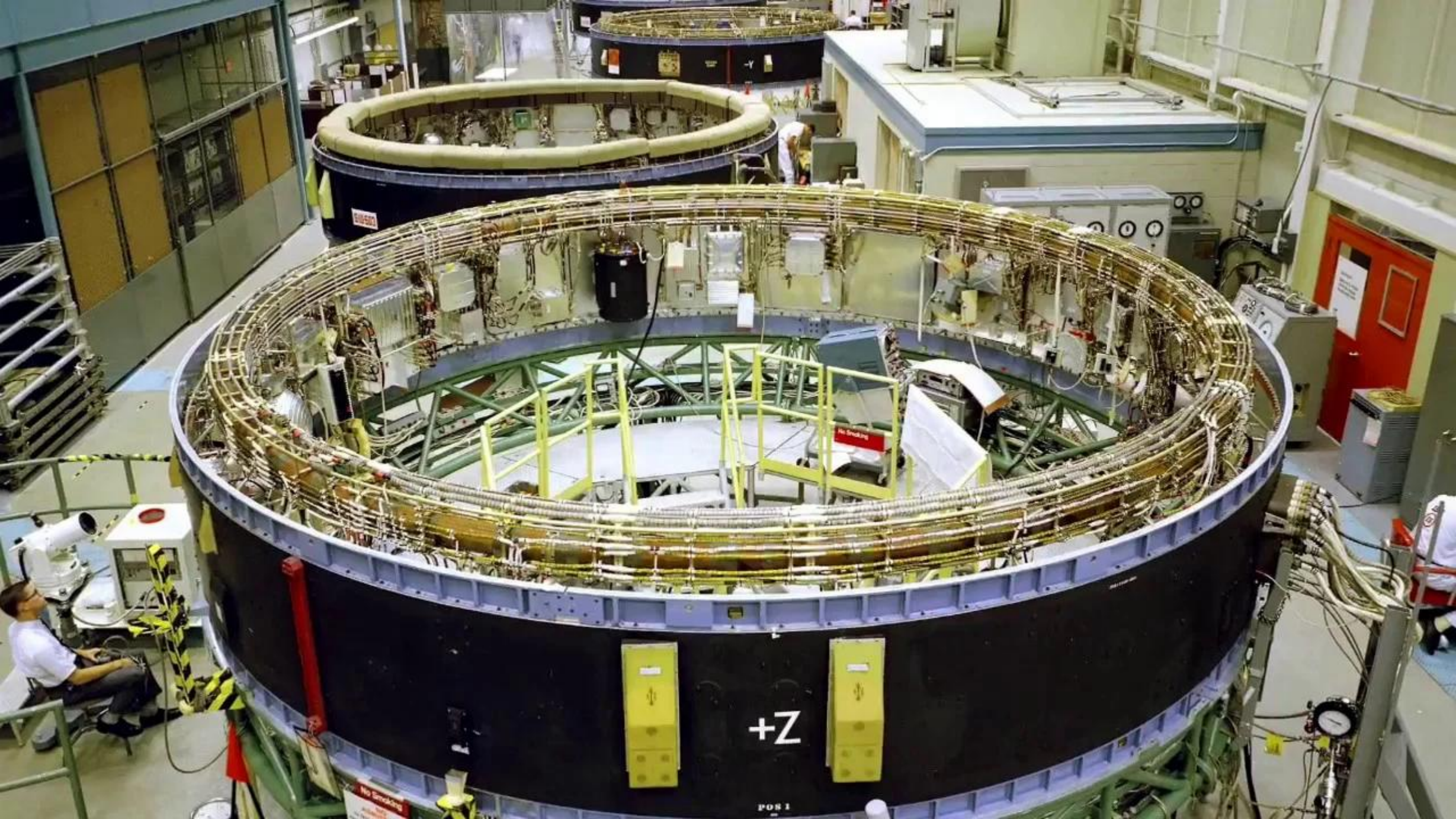
+Z
No Smoking
POS 1

1
00:00:20,650 --> 00:00:16,600
well the excitement of seeing the men

2
00:00:22,960 --> 00:00:20,660
land on the moon and of course the more

3
00:00:25,120 --> 00:00:22,970
important in part that I was more

4
00:00:30,220 --> 00:00:25,130
involved in is the large vehicle so the

5
00:00:32,620 --> 00:00:30,230
actual launch of of Apollo 11 at the

6
00:00:38,350 --> 00:00:32,630
Cape that that I will never forget that

7
00:00:40,840 --> 00:00:38,360
and then the long period of waiting to

8
00:00:42,970 --> 00:00:40,850
file they won the enroute to the moon to

9
00:00:45,940 --> 00:00:42,980
see how everything was going to go and

10
00:00:47,590 --> 00:00:45,950
then the final touchdown on the moon of

11
00:00:50,920 --> 00:00:47,600
course we all had confidence it would

12
00:00:53,920 --> 00:00:50,930
happen but it was a great relief see it

13
00:00:55,930 --> 00:00:53,930

happened I was at the Cape at the time

14
00:00:57,670 --> 00:00:55,940
of the launch of course because we were

15
00:01:00,430 --> 00:00:57,680
involved very heavily in the launch

16
00:01:02,920 --> 00:01:00,440
vehicle I was in the there's two control

17
00:01:05,020 --> 00:01:02,930
rooms there and they have the the

18
00:01:07,200 --> 00:01:05,030
control room where the people on the

19
00:01:10,539 --> 00:01:07,210
consoles and I was in an adjoining

20
00:01:12,609 --> 00:01:10,549
control room where we were readily

21
00:01:16,990 --> 00:01:12,619
available for consultation at that time

22
00:01:19,840 --> 00:01:17,000
so I was there when when the Apollo 11

23
00:01:22,180 --> 00:01:19,850
was launched and that was big thrill

24
00:01:24,070 --> 00:01:22,190
because we'd seen earlier Saturn's

25
00:01:26,070 --> 00:01:24,080
launch but there was nothing like the

26
00:01:30,160 --> 00:01:26,080
one that was supposed to go to the moon

27
00:01:33,630 --> 00:01:30,170
so you know I came home after that

28
00:01:37,060 --> 00:01:33,640
actually our mission was complete once

29
00:01:39,399 --> 00:01:37,070
the we were injected into orbit and on

30
00:01:42,190 --> 00:01:39,409
into the lunar trajectory translunar

31
00:01:45,910 --> 00:01:42,200
trajectory but there was a lot of long

32
00:01:47,620 --> 00:01:45,920
hours and days of waiting to be sure

33
00:01:49,149 --> 00:01:47,630
that everybody else's system worked

34
00:01:52,359 --> 00:01:49,159
because we of course we're not

35
00:01:54,190 --> 00:01:52,369
responsible here at Marshall nor was I

36
00:01:58,630 --> 00:01:54,200
responsible for the actual landing

37
00:02:01,749 --> 00:01:58,640
system so I was at home watching it on

38
00:02:04,770 --> 00:02:01,759

TV when the actual landing occurred and

39
00:02:07,870 --> 00:02:04,780
a lot of people that wanted to be in

40
00:02:10,270 --> 00:02:07,880
somewhere for a party and whatever but I

41
00:02:12,819 --> 00:02:10,280
was I didn't feel I was still too

42
00:02:15,190 --> 00:02:12,829
concerned I wanted to be alone with my

43
00:02:17,410 --> 00:02:15,200
family I think that that was a great

44
00:02:20,410 --> 00:02:17,420
relief great jubilation when it happened

45
00:02:22,660 --> 00:02:20,420
but nothing compared to when they

46
00:02:25,380 --> 00:02:22,670
actually landed back on the earth you

47
00:02:27,240 --> 00:02:25,390
know there was still that concern even

48
00:02:29,460 --> 00:02:27,250
while they won't the moon it was always

49
00:02:34,070 --> 00:02:29,470
the nagging concern is everything going

50
00:02:40,010 --> 00:02:36,760
well if the mission was there the goal

51
00:02:42,350 --> 00:02:40,020
clearly established and we all had

52
00:02:44,600 --> 00:02:42,360
confidence in ourselves there was a lot

53
00:02:46,730 --> 00:02:44,610
of work that led up to the actual

54
00:02:48,590 --> 00:02:46,740
development of the Saturn 5 it certainly

55
00:02:52,100 --> 00:02:48,600
wasn't something that you just made the

56
00:02:54,470 --> 00:02:52,110
big step launched off on developing that

57
00:02:56,360 --> 00:02:54,480
launch vehicle we were already the team

58
00:02:59,750 --> 00:02:56,370
was already in place here even before

59
00:03:02,450 --> 00:02:59,760
NASA and that as the part of ABMA we

60
00:03:04,550 --> 00:03:02,460
were already working on a precursor to

61
00:03:07,370 --> 00:03:04,560
the Saturn launch vehicle and we were

62
00:03:09,380 --> 00:03:07,380
using the systems we had developed for

63
00:03:11,330 --> 00:03:09,390

the army specifically the Jupiter and

64
00:03:15,140 --> 00:03:11,340
the Redstone missiles and if you look at

65
00:03:17,510 --> 00:03:15,150
the Saturn 1 stage that you see on

66
00:03:20,270 --> 00:03:17,520
display at the Museum you see a cluster

67
00:03:21,980 --> 00:03:20,280
of smaller tanks around a large one

68
00:03:23,750 --> 00:03:21,990
that's really a bunch of red stones

69
00:03:26,420 --> 00:03:23,760
clustered around a Jupiter and that's

70
00:03:28,460 --> 00:03:26,430
the way we started we we perfected the

71
00:03:31,370 --> 00:03:28,470
Redstone taking it one step at a time

72
00:03:34,820 --> 00:03:31,380
and then the the Jupiter and then when

73
00:03:37,640 --> 00:03:34,830
we got the charter from the Advanced

74
00:03:40,220 --> 00:03:37,650
Research Projects Agency before NASA to

75
00:03:43,160 --> 00:03:40,230
to already start on a large launch

76
00:03:45,710 --> 00:03:43,170
vehicle we we took that technology which

77
00:03:48,020 --> 00:03:45,720
was very simple and crude compared to

78
00:03:50,690 --> 00:03:48,030
what we have today things were much

79
00:03:54,470 --> 00:03:50,700
simpler back then we digital computers

80
00:03:57,290 --> 00:03:54,480
were almost non-existent and so we did

81
00:04:00,170 --> 00:03:57,300
everything in a in a simpler way then

82
00:04:03,770 --> 00:04:00,180
then we now do things like on the

83
00:04:06,100 --> 00:04:03,780
shuttle program but it was a team that

84
00:04:08,570 --> 00:04:06,110
was built up over a number of years and

85
00:04:10,430 --> 00:04:08,580
we all knew each other and had

86
00:04:13,580 --> 00:04:10,440
confidence in each other and had a good

87
00:04:16,039 --> 00:04:13,590
working relationship and of course the

88
00:04:19,789 --> 00:04:16,049

the thing that held it all together was

89
00:04:22,880 --> 00:04:19,799
dr. von Braun and everybody is respect

90
00:04:25,730 --> 00:04:22,890
for him and he was truly a team leader

91
00:04:28,790 --> 00:04:25,740
and we really worked as a team we had

92
00:04:31,070 --> 00:04:28,800
and you own the cutting edge of

93
00:04:33,830 --> 00:04:31,080
technology you were doing things never

94
00:04:35,600 --> 00:04:33,840
been done before but even though you

95
00:04:37,520 --> 00:04:35,610
didn't have the experience if you ran

96
00:04:40,460 --> 00:04:37,530
into a problem you could always be sure

97
00:04:43,520 --> 00:04:40,470
that there was some specialists within

98
00:04:45,320 --> 00:04:43,530
the center that had a technical

99
00:04:47,340 --> 00:04:45,330
background that could help you get

100
00:04:50,190 --> 00:04:47,350
through that and solve that problem so

101
00:04:52,260 --> 00:04:50,200
it was working it really was a team

102
00:04:53,940 --> 00:04:52,270
effort you hear about the von braun team

103
00:04:56,520 --> 00:04:53,950
that's just that's not just a phrase

104
00:04:59,940 --> 00:04:56,530
that's a fact that's the way it worked

105
00:05:02,040 --> 00:04:59,950
and we all you know the lines of

106
00:05:04,770 --> 00:05:02,050
organization were maybe not as clearly

107
00:05:07,710 --> 00:05:04,780
drawn as some people like to see them

108
00:05:09,330 --> 00:05:07,720
and you know you you try to explain how

109
00:05:11,820 --> 00:05:09,340
the organization worked it's sort of

110
00:05:14,370 --> 00:05:11,830
difficult but it's because we knew each

111
00:05:16,820 --> 00:05:14,380
other and respected each other and work

112
00:05:19,320 --> 00:05:16,830
together and and if there was ever

113
00:05:23,070 --> 00:05:19,330

problems you know we knew the guy at the

114
00:05:25,170 --> 00:05:23,080
top dr. von Braun would step in and make

115
00:05:26,940 --> 00:05:25,180
a decision if there was a difference of

116
00:05:30,390 --> 00:05:26,950
technical opinion and everybody

117
00:05:32,670 --> 00:05:30,400
respected his his judgment I mean all

118
00:05:35,430 --> 00:05:32,680
the way from minor things to very major

119
00:05:38,310 --> 00:05:35,440
things so it was a it was truly a team

120
00:05:44,800 --> 00:05:38,320
effort involving a lot of

121
00:05:49,690 --> 00:05:47,200
well he was I guess he was probably a

122
00:05:52,150 --> 00:05:49,700
genius he was a great communicator but

123
00:05:54,880 --> 00:05:52,160
he was technically very astute and he

124
00:05:57,790 --> 00:05:54,890
had been interested in space from very

125
00:06:00,850 --> 00:05:57,800
early childhood essentially and had such

126
00:06:04,540 --> 00:06:00,860
a tremendous background personally from

127
00:06:08,380 --> 00:06:04,550
his experience even as a teenager and on

128
00:06:10,600 --> 00:06:08,390
into his 20s before he got seriously

129
00:06:14,850 --> 00:06:10,610
into the the missile business and the

130
00:06:18,220 --> 00:06:14,860
space business and he was such a

131
00:06:22,330 --> 00:06:18,230
magnetic personality and he always made

132
00:06:25,750 --> 00:06:22,340
you feel a part of things he never put

133
00:06:27,909 --> 00:06:25,760
anybody down I never saw him chastise

134
00:06:30,070 --> 00:06:27,919
anyone publicly I'm sure he may have

135
00:06:33,700 --> 00:06:30,080
called some people in privately on

136
00:06:35,860 --> 00:06:33,710
occasion but it was always he it was

137
00:06:38,890 --> 00:06:35,870
even an easy man to follow in an easy

138
00:06:41,080 --> 00:06:38,900

man to respect and he made you feel like

139
00:06:43,360 --> 00:06:41,090
you were part of things than that your

140
00:06:47,380 --> 00:06:43,370
opinion counted even from the very

141
00:06:50,200 --> 00:06:47,390
remembrance to to and I'd only been here

142
00:06:55,120 --> 00:06:50,210
three days and was working in the back

143
00:06:57,550 --> 00:06:55,130
of an old warehouse 44 81 on a helium

144
00:06:59,530 --> 00:06:57,560
leak detector with a technician and all

145
00:07:01,360 --> 00:06:59,540
of a sudden here shows up von Braun I'd

146
00:07:03,909 --> 00:07:01,370
been here three days and this was such a

147
00:07:06,940 --> 00:07:03,919
remote area I didn't think I would see

148
00:07:09,490 --> 00:07:06,950
him for months and he showed up with my

149
00:07:11,800 --> 00:07:09,500
lab director wanting to see what what we

150
00:07:13,900 --> 00:07:11,810
were working on and he isn't the lab

151
00:07:16,150 --> 00:07:13,910
director in some difference of opinion

152
00:07:18,490 --> 00:07:16,160
about this technical application of this

153
00:07:20,710 --> 00:07:18,500
device so he turns to me and asked me

154
00:07:23,350 --> 00:07:20,720
what is my opinion and that was

155
00:07:26,350 --> 00:07:23,360
something I noticed from from that very

156
00:07:29,830 --> 00:07:26,360
first event all the way through the

157
00:07:31,900 --> 00:07:29,840
Saturn Apollo program he had he would

158
00:07:34,630 --> 00:07:31,910
always call you in if you were present

159
00:07:36,700 --> 00:07:34,640
for a meeting where a significant

160
00:07:38,440 --> 00:07:36,710
decision was being made he would go

161
00:07:41,950 --> 00:07:38,450
around the room and ask well what is

162
00:07:43,659 --> 00:07:41,960
your opinion and he he would whether he

163
00:07:45,010 --> 00:07:43,669

was sitting you were frontline are

164
00:07:46,570 --> 00:07:45,020
sitting at the table or whether you're

165
00:07:48,760 --> 00:07:46,580
sitting in the back of the room he would

166
00:07:51,580 --> 00:07:48,770
always look around and you try to get to

167
00:07:54,310 --> 00:07:51,590
draw the opinions out of of everybody

168
00:07:56,469 --> 00:07:54,320
and be sure that that everyone felt they

169
00:07:58,300 --> 00:07:56,479
were part of things so I think that's

170
00:08:00,810 --> 00:07:58,310
the key to it he was truly a team

171
00:08:05,590 --> 00:08:00,820
he was a leader and that everyone

172
00:08:09,340 --> 00:08:05,600
respected and he had that in a technical

173
00:08:11,890 --> 00:08:09,350
capability of understanding enough about

174
00:08:14,879 --> 00:08:11,900
all disciplines that he could he could

175
00:08:18,070 --> 00:08:14,889
explain it he come through the lab and

176
00:08:21,030 --> 00:08:18,080
ask you a few questions about some

177
00:08:23,470 --> 00:08:21,040
intricate device you're working on and

178
00:08:25,629 --> 00:08:23,480
new exciter he'd come through and

179
00:08:28,300 --> 00:08:25,639
explained in detail that same device to

180
00:08:30,220 --> 00:08:28,310
a visitor he he comprehended things well

181
00:08:32,709 --> 00:08:30,230
enough to and he could put things in

182
00:08:35,200 --> 00:08:32,719
terms that the layman could understand

183
00:08:37,360 --> 00:08:35,210
and I think that was part of his great

184
00:08:40,000 --> 00:08:37,370
value not only communicator with

185
00:08:42,279 --> 00:08:40,010
internal within Marshall and Nasser but

186
00:08:44,530 --> 00:08:42,289
his ability to communicate with Congress

187
00:08:48,040 --> 00:08:44,540
I mean he was highly respected because

188
00:08:50,110 --> 00:08:48,050

he could put things in terms that the

189
00:08:52,420 --> 00:08:50,120
layman or the politicians could

190
00:08:54,329 --> 00:08:52,430
understand so he was an invaluable asset

191
00:09:00,930 --> 00:08:54,339
from that standpoint just only

192
00:09:06,050 --> 00:09:03,480
well I was responsible for at that time

193
00:09:08,610 --> 00:09:06,060
for the instrument unit which

194
00:09:11,010 --> 00:09:08,620
incorporated all of the guidance and

195
00:09:13,590 --> 00:09:11,020
control instrumentation communication

196
00:09:16,380 --> 00:09:13,600
computer systems and also the control

197
00:09:20,330 --> 00:09:16,390
actuators that are up and down the the

198
00:09:23,610 --> 00:09:20,340
stages of Saturn I had been involved in

199
00:09:25,890 --> 00:09:23,620
the development earlier of the control

200
00:09:28,020 --> 00:09:25,900
systems and then became responsible for

201
00:09:32,880 --> 00:09:28,030
the total system before the actual

202
00:09:34,950 --> 00:09:32,890
landing that was in 1968 when I became

203
00:09:36,750 --> 00:09:34,960
the director of astronautics laboratory

204
00:09:38,460 --> 00:09:36,760
which had I had the responsible for the

205
00:09:42,210 --> 00:09:38,470
total instrument unit

206
00:09:44,510 --> 00:09:42,220
well the instrument unit was built here

207
00:09:47,910 --> 00:09:44,520
it was focused here in hospital we

208
00:09:50,820 --> 00:09:47,920
realized from the outset that we that

209
00:09:53,130 --> 00:09:50,830
this was going to be a very complex job

210
00:09:56,810 --> 00:09:53,140
to bring together essentially the the

211
00:10:00,210 --> 00:09:56,820
total brains of the Saturn 5 vehicle and

212
00:10:04,160 --> 00:10:00,220
that would be desirable to have it very

213
00:10:06,570 --> 00:10:04,170

closely under control of the local

214
00:10:08,150 --> 00:10:06,580
Marshall group because we had already

215
00:10:10,440 --> 00:10:08,160
done a great deal of the

216
00:10:13,980 --> 00:10:10,450
conceptualization of how the system

217
00:10:17,790 --> 00:10:13,990
would work so the plan was to bring a

218
00:10:20,760 --> 00:10:17,800
contractor to Huntsville who who would

219
00:10:22,830 --> 00:10:20,770
have the the background to do this and

220
00:10:25,260 --> 00:10:22,840
this would not be a typical aerospace

221
00:10:27,270 --> 00:10:25,270
company it would not be a Boeing or

222
00:10:31,290 --> 00:10:27,280
McDonnell Douglas or company that would

223
00:10:35,400 --> 00:10:31,300
normally build the the structure in the

224
00:10:37,560 --> 00:10:35,410
propulsion system so we dr. von Braun

225
00:10:40,920 --> 00:10:37,570
decided we should select the company

226
00:10:43,890 --> 00:10:40,930
that that had the in-depth technical

227
00:10:48,240 --> 00:10:43,900
capability in the electronic field an

228
00:10:50,640 --> 00:10:48,250
electrical field and we selected IBM and

229
00:10:53,430 --> 00:10:50,650
a small group of us are well remember we

230
00:10:55,350 --> 00:10:53,440
went to IBM and and looked at their

231
00:10:57,060 --> 00:10:55,360
situation there at a we go to see if

232
00:10:59,910 --> 00:10:57,070
they had the kind of capability we were

233
00:11:01,980 --> 00:10:59,920
looking at and and we decided that IBM

234
00:11:03,630 --> 00:11:01,990
was certainly a good good choice for

235
00:11:06,000 --> 00:11:03,640
that system where the emphasis would be

236
00:11:08,850 --> 00:11:06,010
not only even though this is a piece of

237
00:11:10,980 --> 00:11:08,860
the structure the importance of it is

238
00:11:13,380 --> 00:11:10,990

the the things that are inside that

239
00:11:14,879 --> 00:11:13,390
structure and it's just chock full of

240
00:11:19,650 --> 00:11:14,889
electrical electronic

241
00:11:23,160 --> 00:11:19,660
an electromechanical system so dr. von

242
00:11:25,949 --> 00:11:23,170
Braun convinced IBM that they should

243
00:11:28,799 --> 00:11:25,959
actually set up a facility here in

244
00:11:31,799 --> 00:11:28,809
hospital he was a very persuasive man

245
00:11:33,509 --> 00:11:31,809
and whether they really that was

246
00:11:35,639 --> 00:11:33,519
necessarily in their best business

247
00:11:37,759 --> 00:11:35,649
interest or not they they certain agreed

248
00:11:40,739 --> 00:11:37,769
to do it and they moved a group here and

249
00:11:44,639 --> 00:11:40,749
set up the group that that actually

250
00:11:47,220 --> 00:11:44,649
implemented the the instrument unit

251
00:11:49,619 --> 00:11:47,230
design of course the elements of the

252
00:11:51,569 --> 00:11:49,629
instrument unit were built by a number

253
00:11:53,389 --> 00:11:51,579
of different contractors it is the

254
00:11:55,590 --> 00:11:53,399
brains of the vehicle it has the

255
00:11:58,139 --> 00:11:55,600
stabilized platform with the

256
00:12:01,470 --> 00:11:58,149
accelerometers and gyros that that give

257
00:12:04,650 --> 00:12:01,480
you the information of what your angle

258
00:12:09,090 --> 00:12:04,660
is attitude angle and your position in

259
00:12:10,710 --> 00:12:09,100
flight and it has the the key part of

260
00:12:13,499 --> 00:12:10,720
the instrument unit at the heart of it

261
00:12:16,349 --> 00:12:13,509
would be the the computer which was a

262
00:12:18,900 --> 00:12:16,359
triple modular computer and that was

263
00:12:21,600 --> 00:12:18,910

designed and built by IBM and that was

264
00:12:23,819 --> 00:12:21,610
one of the reasons for selecting them

265
00:12:27,030 --> 00:12:23,829
but that was the most complex piece of

266
00:12:29,850 --> 00:12:27,040
the of the instrument unit and we

267
00:12:32,609 --> 00:12:29,860
evolved this technique together with IBM

268
00:12:35,429 --> 00:12:32,619
to build a computer that even with

269
00:12:37,799 --> 00:12:35,439
failures you could still continue and

270
00:12:41,579 --> 00:12:37,809
that's what we called a triple modular

271
00:12:45,530 --> 00:12:41,589
redundancy same several failures and

272
00:12:47,789 --> 00:12:45,540
would continue to operate so that

273
00:12:49,859 --> 00:12:47,799
developing that computer and the

274
00:12:53,069 --> 00:12:49,869
software that went with it as well as

275
00:12:56,369 --> 00:12:53,079
all the peripheral systems that the

276
00:12:59,069 --> 00:12:56,379
input sensors gyros rate gyros

277
00:13:01,319 --> 00:12:59,079
accelerometers angle-of-attack sensors

278
00:13:03,119 --> 00:13:01,329
all that information goes into that

279
00:13:07,439 --> 00:13:03,129
computer and then information that comes

280
00:13:09,840 --> 00:13:07,449
out commands the control actuators on

281
00:13:11,849 --> 00:13:09,850
the stage there's a network that goes up

282
00:13:13,710 --> 00:13:11,859
and down the total vehicle the command

283
00:13:16,499 --> 00:13:13,720
they control actuators that gimble the

284
00:13:18,629 --> 00:13:16,509
engines but all of that was concentrated

285
00:13:21,179 --> 00:13:18,639
here along with the instrumentation the

286
00:13:24,419 --> 00:13:21,189
power systems the batteries everything

287
00:13:28,629 --> 00:13:24,429
to be integrated right here in hospital

288
00:13:31,780 --> 00:13:28,639

and that worked out very well we

289
00:13:34,030 --> 00:13:31,790
didn't have any failures of that system

290
00:13:36,129 --> 00:13:34,040
that even even this triple modular

291
00:13:39,129 --> 00:13:36,139
redundancy we had in that flight

292
00:13:42,069 --> 00:13:39,139
computer that never was a single flight

293
00:13:45,189 --> 00:13:42,079
failure so we even though in that sense

294
00:13:47,919 --> 00:13:45,199
we over designed in a sense that we had

295
00:13:49,960 --> 00:13:47,929
but that was the most complex part of

296
00:13:53,559 --> 00:13:49,970
the system and we felt that we had to

297
00:13:56,650 --> 00:13:53,569
have that capability but it was it is

298
00:13:58,449 --> 00:13:56,660
the brains of the system and keeping it

299
00:14:00,879 --> 00:13:58,459
on two very close control and close

300
00:14:03,369 --> 00:14:00,889
scrutiny here where they're all the

301
00:14:10,290 --> 00:14:03,379
system engineering was done was a key

302
00:14:15,630 --> 00:14:12,329
well it certainly was a tremendous

303
00:14:18,420 --> 00:14:15,640
achievement and I think it was it was

304
00:14:22,470 --> 00:14:18,430
just based on a focus of a goal it was

305
00:14:24,810 --> 00:14:22,480
set it was new new technology and it

306
00:14:27,389 --> 00:14:24,820
certainly was a major achievement and

307
00:14:29,880 --> 00:14:27,399
the fact that that this program was

308
00:14:33,269 --> 00:14:29,890
carried out without any flight

309
00:14:36,180 --> 00:14:33,279
casualties is is a very phenomenal thing

310
00:14:38,880 --> 00:14:36,190
when you think of the thousands and even

311
00:14:42,110 --> 00:14:38,890
hundreds of thousands of parts that had

312
00:14:45,090 --> 00:14:42,120
to work and even though we used

313
00:14:47,610 --> 00:14:45,100

techniques redundancy techniques so if

314
00:14:50,550 --> 00:14:47,620
you had a failure one failure some other

315
00:14:53,430 --> 00:14:50,560
system would would back up one that had

316
00:14:55,530 --> 00:14:53,440
failed that was certainly not Universal

317
00:14:58,380 --> 00:14:55,540
there are many many many single failure

318
00:15:01,670 --> 00:14:58,390
points in in the Saturn fire vehicle and

319
00:15:04,710 --> 00:15:01,680
the fact that that vehicle could be

320
00:15:06,810 --> 00:15:04,720
constructed and tested in a manner that

321
00:15:10,350 --> 00:15:06,820
that you could actually accomplish these

322
00:15:12,090 --> 00:15:10,360
missions with no flight fatality of

323
00:15:14,250 --> 00:15:12,100
course there was the one unfortunate

324
00:15:16,290 --> 00:15:14,260
incident on the on the pad and that was

325
00:15:18,870 --> 00:15:16,300
back when we had a full oxygen

326
00:15:21,120 --> 00:15:18,880
atmosphere and the spark electrical

327
00:15:23,850 --> 00:15:21,130
spark had actually ignited it and so we

328
00:15:25,740 --> 00:15:23,860
had to go back and restructure reassess

329
00:15:29,550 --> 00:15:25,750
and come up with a less dangerous

330
00:15:32,400 --> 00:15:29,560
approach there but just the fact that

331
00:15:35,690 --> 00:15:32,410
all of that happened and and that we

332
00:15:38,670 --> 00:15:35,700
really did it without any human

333
00:15:41,220 --> 00:15:38,680
fatalities I think is phenomenal it's

334
00:15:42,900 --> 00:15:41,230
really one of the greatest achievements

335
00:15:44,670 --> 00:15:42,910
that I've certainly the greatest

336
00:15:47,850 --> 00:15:44,680
achievement I've ever witnessed and I

337
00:15:51,000 --> 00:15:47,860
would say you could go back centuries