Pit production scenarios 3/31/22

A.		A. All LANL production, PF-4 only, 30 ppy steady average, 2 production shifts, no delay (if preferred, see as "40 ppy" w/ 25% downtime)						B. All LANL, 30 ppy steady average, delayed 2 years (likely)			C. All LANL, 30 ppy steady average, delayed 4 years			D. All LANL, 41 ppy average ("≥30 ppy")	
		D. pits	PPI pits	Q pits	WR pits	∑ WR pits		WR pits	∑ WR pits		WR pits	∑ WR pits			
	2021	?	?	?	0	**0**	∑ WR pits, 10 ppy	0	**0**	2021	0	**0**	2021	0	0
	2022	?	?	?	0	**0**		0	**0**	2022	0	**0**	2022	0	0
	2023	?	?	?	1	**1**	1	1	**0**	2023	1	**0**	2023	1	1
	2024				10	**11**	11	5	**5**	2024	5	**5**	2024	10	11
	2025				20	**31**	21	10	**15**	2025	5	**10**	2025	20	31
	2026				30	**61**	31	10	**25**	2026	5	**15**	2026	30	61
	2027				30	**91**	41	20	**45**	2027	10	**25**	2027	41	102
	2028				30	**121**	51	30	**75**	2028	10	**35**	2028	41	143
GBSD I. D.	2029				30	**151**	61	30	**105**	2029	20	**55**	2029	41	184
W87-1 FPU	2030				30	**181**	71	30	**135**	2030	30	**85**	2030	41	225
	2031				30	**211**	81	30	**165**	2031	30	**115**	2031	41	266
W93 FPU?	2032				30	**241**	91	30	**195**	2032	30	**145**	2032	41	307
SRPPF CD4, or	2033				30	**271**	101	30	**225**	2033	30	**175**	2033	41	348
full	2034				30	**301**	111	30	**255**	2034	30	**205**	2034	41	389
production?	2035				30	**331**	121	30	**285**	2035	30	**235**	2035	41	430
GBSD F. D.	2036				30	**361**	131	30	**315**	2036	30	**265**	2036	41	471
	2037				30	**391**	141	30	**345**	2037	30	**295**	2037	41	512
W87-1 LPU	2038				30	**421**	151	30	**375**	2038	30	**325**	2038	41	553
	2039	(prev. estimated yr PF-4 end-of-life)			30	**451**	161	30	**405**	2039	30	**355**	2039	41	594
	2040				30	**481**	171	30	**435**	2040	30	**385**	2040	41	635

Assume: normal distribution EOL date, mean = 2039	After end-of-life (EOL) failure, no pits will be produced. Near EOL, downtime will increase.				
cumulative p(fail)	A. WR pits until failure, zero afterwards	B. WR pits until failure, zero afterwards	C. WR pits until failure, zero afterwards	D. WR pits until failure, zero afterwards	This exercise is not used in the text that follows. Consider it a thought experiment, a crude attempt to bring a measure of reality into idealized production assumptions at LANL.
0.04	0	0	0	0	
0.04	0	0	0	0	
0.05	1	0	0	1	
0.07	10	5	5	10	
0.08	29	14	9	29	
0.10	55	23	14	55	
0.12	80	40	22	90	
0.14	104	65	30	123	
0.16	127	88	46	155	
0.18	148	111	70	185	
0.21	167	130	91	210	
0.24	183	148	110	233	
0.27	198	164	128	254	
0.31	208	176	141	268	
0.34	218	188	155	284	
0.38	224	195	164	292	
0.42	227	200	171	297	
0.46	227	203	176	299	
0.50	226	203	178	297	
0.54	221	200	177	292	

Scenarios: How many W87-1s are needed?	Assume W87-0 total population = 530 (from https://www.tandfonline.com/doi/pdf/10.1080/00963402.2020.1859865?needAccess=true, less 10 over 2020-2030)		How many new pits are needed 2030-2038?	
1a. None: all 450 MMIIIs are retired, GBSD not built			None. Stockpile pre-2069 pit requirements reduced by 250+600 (MIRV)+60 (surv. units) +85 (spares) = 995	
1b. None: all 450 or fewer missiles x 1 W87-0 warhead			None now but ICBMs not retired add to 2039-2049 pit production requirements, almost triply so if MIRVed	
1c. None: all of the new GBSD warheads "needed" could be built from an abundant supply of non-W87-1 reused pits, e.g. W76s. NNSA mentioned two non-W87 pit reuse candidates.			None now but ICBMs not retired add to 2039-2049 pit production requirements, almost triply so if MIRVed	
2. 200 missiles x 1 warhead, + 20 spares (10%), + 30 surveillance units = 250	Assumes retaining 250 W87-0s, 25 spares, 30 surv. units = 305	225 W87 pits available	25 pits needed w/30 surv. units	LANL alone might do it; older pits will need replacement 2039-2049
3. 200 missiles x 3 warheads, + 60 spares + 30 surveillance units = 690	Assumes retaining 250 W87-0s, 25 spares, 30 surv. units = 305	225 W87 pits available	465 pits needed w/30 surv. units	No, LANL alone can't do it except under scenario D, ~41 ppy average.
4. 450 missiles x 3 warheads, + 135 spares, + 30 surveillance units = 1,515	Assumes no W87-0s retained	530 W87 pits available	985 pits needed w/30 surv. units	No, LANL can't do it.

Could LANL also produce a new-pit W93 by 2039 under any scenario? Assume 430 pits needed. The answer is no. LANL cannot shift from W87-1 production until SRS production is going strong. Even then, would take time -- years -- to qualify the new production line and new W93s. LANL can't make any significant number of W93s by 2039 under any scenario if LANL makes any significant number of W87-1s.

Obviously, the more GBSD warheads made with reused pits, the greater the burden on post-2038 production. Pit reuse shifts production to later times but does not decrease it. Only partial disarmament does that.

Under LANL scenario 2., with the optimistic assumption of full SRS production of W93s starting in 2035 at >80 ppy (average 103 ppy), SRS could make enough new-pit W93s for a 2035-2039 LEP. This assumes some prior development work at LANL. How could that happen if LANL were still making W87-1 pits? I think a new-pit W93 in the 2030s can only happen if LANL begins W93 development and training in the early 2030s and b) SRS begins full-scale production no later than 2035 or 2036 in a pinch.

There can be a new-pit W87-1 built in the 2030s or a new-pit W93 built in the 2030s but not both, even with two production sites, except under W87-1 scenario 2 (high W87 pit reuse, low W87-1 production) with few W87 pits required, allowing LANL to switch over to W93s ~2030.

Without MIRV, hardly any new pits are needed in the 2020s and 2030s for W87-1 in the first place. ~25 pits over 13 years, ~ 2 ppy, average. But to the extent pit reuse is used and warheads kept, new replacement pits will be needed 2039-2049.

Note that fielding W87-1 + W87-0 creates need for two sets of (spares + surveillance units), instead of one. The stockpile penalty is about 30 warheads for a 30-year LEP.

Assume no fielded pits >80 yrs old, i.e. all current pits are too old after 2060 (for the oldest pits) to 2069 (for the newest pits).

W87-0 was produced 1986-1988 (Chuck Hansen, p. 203). Its pits will reach 80 yrs old over 2066-2068, so 30-yr W87 LEP (or a W87-1 with W87 pit reuse) can't be done later than 2036-2038. Compare DoD 2020 Nuclear Matters: LEP in 2035-2040. Agrees.

A 20-year-life W87-0 LEP (or a new-pit 30-year W87-1) can be done as late as 2046-2048. Only 20 surveillance units would be required for a 20-year warhead.

W88 was produced in 1989. Its pits will be 80 yrs old in 2069. A 30-yr W88 LEP (or W93) with pit reuse requires an LPU of 2039. After that, an LEP with pit reuse and a shorter assumed life is possible, or else an LEP with new pits, or else retirement. Compare DoD 2020 NM: LEP in 2035-2040.

A 20-year W8 A 20-year W88 LEP (or old-pit W93 using W88 pits, or new-pit 30-year W93) can be done as late as 2049. Only 20 surveillance units would be required for a 20-year warhead.

Thus, pit reuse fades away for 30-yr LEPs or new builds over the 2030-2039 decade. For LEPs or new builds with 20 year lives, pit reuse can be used through 2040-2049.

W76s were produced from 1978-1987 (Hansen, p. 206). Pits will be 80 years old in 2058-2067. 30-year LEPs or pit reuse builds with this pit can be done as late as 2028 to 2037; 20-year LEPs or builds as late as 2038-2047.

Suppose we must plan for a total stockpile of 3,800 warheads as at present (1,800 deployed, 2,000 reserves, spares, and surveillance units), at a maximum. This we might estimate at 150 surveillance units and 380 spares (10%), or (1,770 hedge + 1,800 deployed) = 3,570 to compare with the below.

Suppose production of new pits 2026 through 2069, 43 years for LANL. At SRS, 2035-2069, 34 years.

Here we assume that no pit older than 2060-1980 = 80 years is left in the stockpile or kept in a LEP. This follows DoD Nuclear Matters 2020.

	Initial pits in 2030	Duration, years	ave. ppy	∑ WR pits
LANL only	181	43	30	1471

(Compare DoD *Nuclear Matters* chart, slide 7 in gm 10/1/21 briefing; pit ages at replacement are 45-75 years there.)

5 types, 150 surveillance units needed, 10% spares imply ~**1,174 deployed + hedge**, not counting spares and surveillance units

Over these years, LANL will require a whole new pit factory in addition to the one now being built. There is no obvious place at LANL where an adequate, modern facility could be built. Nor is the labor force likely to be available.

This is two-shift production. **Pit reuse does not enter into the long-term capacity required.**

This is 39% of today's total arsenal or 36% counting surveillance units.

We can argue that this is plenty for nuclear deterrence but there is no proposal on the table for such deep cuts.

Here we use the literal 30 ppy, average, because we believe this is IT, the maximum capacity at LANL under optimistic assumptions unless an entire new production complex is built at great cost, risk, and delay.

What limits LANL? A) labor availability; B) waste handling capacity; C) traffic, housing; D) regional water, regional education and social factors; E) age, inadequacy of buildings and need for continuous construction; F) culture (safety, R&D vs. production) (institutional and regional); F) seismicity, topography

SRS only	0	34	103	3502

SRS production assumed to begin in 2035 at ≥80 ppy/yr, i.e. 103 ppy average, single-shift

Under these assumptions, the SRS factory would be adequate for any foreseeable stockpile, with single-shift production. SRS could have flexibility and surge capacity (two shifts) also.

Subtract (150 surveillance units plus 350 spares) to get **3002 deployed+hedge, which is comparable to today's arsenal and almost three times what LANL could support with the present planned emergency factory (and a new factory complex of similar size that would need to be built starting in the 2020s).**

Would LANL provide resilience? LANL provides the opposite of resilience. LANL production would NOT be adequate in the event of an emergency at SRS, not even close, even with building a SECOND LANL factory, because the latter wouldn't be ready in time and because of LANL's other deficiencies.

Pausing the SRS project would result in loss of the workforce being gathered. It might *never* be able to restart. Missing one year could be fatal. Stringing the project along at a low funding rate would also kill it.

What about if SRS were continued but delayed 5 years to full production? Thus, 29 years production x 103 = 2,987.

LANL + SRS	181		133	4973	Baseline 30 ppy at LANL, 103 ppy at SRS gives 4,973 total pits made through 2069. LANL needs new production facilities to do this, if possible at all.
LANL + SRS	71	34	113	3963	**LANL continues at a training & process development scale of 10 ppy, SRS begins full production in 2035 for 34 more years**
LANL + SRS	71	29	113	3448	**There is a 5-year delay at SRS resulting in 29 years production by 2069, LANL continues at 10 ppy**

[For a new pit facility built-to-purpose capacities are likely, or could be, these: a) baseline capacity X; b) surge to 1.5X (still on single shift); c) full capacity = 2x surge or 3x baseline, using two shifts (see DPAG study, 1999).] We know SRPPF will have multiple production lines and built-in surge capacity.

The fate of RFP building 770 is the fear. The fear is that SRPPF will never get off the ground and will require major rework, delays, etc. It is a justified fear. But how does LANL correct for that problem? It doesn't. In fact, inadequate, unsafe LANL pit production competes with setting up adequate SRS production.