Saturn I MLV proposals, The LEO INTs:

This is as comprehensive of a list of all the various Saturn IB proposals under the MLV study as can be easily surmised. Early on, those rockets based on Saturn I flight profile (LEO only) received INT-x designations. Those designed for beyond LEO received MLV-x designations and are almost exclusively Saturn V derivatives.

Knowing this, we can quickly break the INT series into three basic Rocket types. They are the direct Saturn I replacement, the Saturn II based on the S-II stage from Saturn V, and the Saturn V S-IC derived LEO Rockets.

For clarity's sake, Rockets are denoted with the old C series designations (C-1, C-5, etc.) The reason becomes important when you add the un-built C-2, C-3, C-4, etc., to the mix as they all had stages of the same name even though they were rocket specific.

Unless specifically denoted in the variant, any reference to a MLV stage eg MS-IVB, is for the standard tank but strength optimized stage. No stretches should be assumed here. The EXCEPTION: There are calls for a S-IVC on some of these proposals. To be clear this is the ACTUAL ORIGIONAL S-IVC not the awesome twin engine S-IVC from the amazing Alt-History story Eyes Turned Skyward by E of Pi (for clarities sake let's call that an ES-IVC.)

Saturn I

INT-05 family. This is two generations of proposals; the Original INT-05 had way too much acceleration for manned launches (one of the pre-requisites for the study.) The 2nd study's results, the INT-05A, offer significant changes. A further INT-05B exists as well, but the data is sketchy.

INT-05: MS-IVB atop a re-designed Saturn S-IB to S-IVB interstage. Half-length "full acceleration" AJ-260. 56,000kg to LEO, but the g-force loads would be excessive (approaching 6x the force of gravity)

INT-05A: Improvement to how the AJ-260 would be engineered and built, utilizing the latest advances in Solid Propellant grain manipulation, a Full "137ft 5in" length AJ-260 with an Augmented thrust profile would be used. 43,000kg to LEO but Man safe (less than 3.5g acceleration)

INT-05B: Several websites and documents mention a -05B version, but none spell out anything about it except that it existed. I am ASSUMING that this would be a "thrust profiled" short AJ-260. The lower acceleration would cause a decline in the payload to orbit around 10-15,000kg or about the same as a standard late Saturn IB.

INT-11 to INT-15 family. This is a series of proposals for either a standard S-IB(C-1) stage or one with a 20 ft stretch… In all cases, either four UA-1205s are used or in conjunction with the 20ft stretch 4 UA-1207s. Various combinations of Air-lit or ground-lit H-1s and even removing some of the H-1s were studied in this group. Assume that if the SRM equipped is UA-1207 that the core stage has a 20ft stretch. In every case in this series, 4 of the 8 stabilizing fins are removed from the 1st stage of the Saturn Rocket.

INT-11(1205): As Saturn IB in all respects except 4 UA-1205 SRMs are used to carry the Rocket as the 0 stage. The First stage (8 H-1s) are ignited approximately 5 seconds before SRM burn out at altitude. Payload not specified but believed to be slightly less than the 1207 version's 48,000kg

INT-11(1207): As Saturn IB in all respects except 4 UA-1207, SRMs are used to carry the Rocket as the 0 stage. The first stage (8 H-1s) is ignited approximately 5 seconds before SRM burn out at altitude. Payload is 48,000kg First stage tank stretch is designated S-IB-11

INT-12: As Saturn IB but only the outer 4 H-1s are fitted. Equipped with 4 UA-1205 SRMs and both the UA-1205s and the H-1s are ignited at launch. 34,000kg to LEO

INT-13: Again using two versions of the Titan SRM, the INT-13 was proposed as a 2x SRM + core Saturn IB. The base version would add two UA-1205s to ignite at launch with all 8 H-1 engines. The stretched or INT-13-11 would use 2x UA-1207s. Payload is listed for the INT-13-11 as 36,500kg to LEO. I could find no payload listed for the base INT-13.

INT-14: Three distinct rockets this one. The INT-14 introduced the idea of using 4x of the Minuteman's M55/TX-55/TU-122 engine (M55 being the Military designation for both the TX-55 and TU-122.) With this would be combined a standard Saturn S-IB, a 10ft Stretched S-IB(C-1) tank or a 20ft stretched tank like the INT-11 above. Each side would carry 2x M55s nestled side by side between each fin. Data is for the 20ft stretch. H-1s ignited at launch. 23,180kg LEO payload.

INT-15: The final version of this series of proposals. The INT-15 was again studied in 0, 10 and 20ft stretch to the S-IB(C-1) stage. In this case we have data for the 10ft stretch. 8x Minuteman M55/TX-55/TU-122 engines would be utilized, No indication if the burn profile is ALL/HALF or some other combination. Assuming all burned at once. 26,000kg to LEO.

The INT-16: On the Subject of Solids and Saturn, after the INT-05 was deemed too high of acceleration for launch, several companies investigated the use of clustered Titan SRMs in lieu of the monolithic AJ-260. IN the case of INT-16 the idea of using the UA-1205 as a 2 stage system before starting the S-IVB was introduced. 2 to 5 UA-1205,1206 or 1207s would surround 1 to 3 of the same SRM, with the outer 2 to 5 being ignited first and the inner 1 to 3 being ignited second. To be clear the UA-1206 talked about here is a full 6 segment version of the 120" CSD SRM. For clarity's sake, I will denote this as the UA-1206F. This is NOT the UA-1206 that first flew on Titan 34D. A conic Interstage would be developed as the stack of

120” SRMs would be larger than the base diameter of the Saturn IB. In fact, a new version of the UA-120x would have been developed that used actual Gimbal Thrust Vectoring instead of Liquid injection. It was this that put the proposal out of sight as the costs involved, given the technology was being developed at competing companies was excessive. Supposedly a 5x UA-1205 first stage, arranged 4 +1, would lift 28,000kg to LEO. An extremely optimistic number without creating an excess of acceleration in my opinion.

Saturn II family:

INT-17: INT-17 was a paper study that latched onto the Paper engine known as the HG-3. The goal was to showcase that while high-power engines COULD be made, putting them on a Saturn S-II(C5) stage would not make it fly well or with a viable payload. This was done as a contrast to the latter INT-18 and INT-19 proposals for Saturn II which both showcased that with existing technology, it was cheaper and effective to replace the Saturn I completely with Saturn V derived components.

Unrelated to the Initial INT-17 “study” Is a valid proposal based on the Boeing MLV-SAT-V3B. Let’s call it the INT-17A.

INT-17A: Viable alternative to the paper study based on nonexistent hardware. Boeing’s MLV-SAT-V3B lost it’s MS-IC stage variant and wings were added to the MS-II stage variant. MS-II received a 15.5 or 16.5ft stretch (two editions of the original report each have a different number here.) The engine section was modified to take 7x of the very powerful J-2T-400k variant of the Advanced Development Program Aerospike Engine (ADP-AE.) While not mentioned in any documents, mostly because its contract was not let for another 3 years, the LTBE or Linear Test Bed Engine AKA the J-2L could have using the same techniques developed 400k lbf thrust and met the requirements for this INT-17A.

The second stage of the INT-17A would be a 16.5ft stretched MS-IVB powered by a single ADP-AE engine of 400k lbf thrust. When combined the INT-17A had the potential of 132,000lbs in a 100nm 72degree Low Earth Orbit. Interestingly you could combine this with the S-IVC’s in line docking capabilities to more effectively build a beyond LEO “Tinker Toy” vessel. Both the LBTE and ADP-AE fitting within the volume envelopes of the J-2 heritage engine on the S-IVB and S-IVC stages.

INT-18: The true workhorse of the Saturn II, the INT-18 would combine 2, 4 or even 5 120” Titan SRMs. The use of stretched tanks was not studied under this series of proposals but the mounting of the 120” SRMs practically calls for it. The strap on SRMs to be used were UA-1204, UA-1205 and UA-1207 in 2 or 4 arrays, Latter it was proposed to use the unbuilt UA-1206F as well, but I have never seen a full accounting of any performance and can guess that the payload would have fallen roughly between the UA-1205 and UA-1207’s. The INT-18 was conceptualized in so many different configurations it is hard to keep track. Be it with 4 UA-1204s and a S-IVB upper stage, or 4 UA-1207s and NO upper stage… the range and breadth of payloads and capabilities of the INT-18 is amazing. The documented performance runs from

21,300 to 66,400kg to LEO. This gives rise to my belief that the Saturn II would have become the first truly modular Rocket, something that MSFC engineers and scientists strove to develop with the ~~Saturn~~ Juno V rocket from the start! Here is I hope a simple chart of the "part variants." Play legos yourself and see what you can do! The INT-18 should almost have a MLV designation because with certain combinations of tankage, fuel and engines you can launch a significant sized payload beyond LEO.

Saturn II INT-18 major components

Liquid stage	Solid Stage
S-II(C5)	UA-1204
MS-IIA(MLV)	UA-1205
MS-IIB(MLV)	UA-1206F
S-IVB(C-1)	UA-1207
S-IVB(C-5)	
MS-IVB(C-5)	
S-IVC (NOT ETS!)	

Engine Choices for all of the various Liquid stages:

J-2	J-2 Sea Level	J-2S	J-2S Sea Level	J-2T	J-2L*	Advanced (RL-20)

*Also know as the Linear Test Bed Engine (LTBE) and is currently in the to-do list of EStreetRockets Rocket Motor Menagerie

INT-19. Almost a footnote in the development of the INT-18 was the fact that even with it's modularity The INT-18 was TOO good for many LEO payloads that might be large. Enter the INT-19. Combining the already studied Minuteman first stage (the above mentioned M55) with the basic Saturn II premise of a Saturn S-II(C-5) stage with a Saturn S-IVB(C-1 or C-5 depending on actual use,) stage with Solids to help get it off the ground and you get a really fat Delta Rocket. It was the NASA Delta Rocket's then proposed (and shortly to fly) use of small solid boosters that started the genesis of the INT-19. The INT-19, like the INT-18 before it would trade off fuel load for payload. In every case the Saturn S-II(C-5) stage would be ignited on the ground and in every case it would be a sea level rated engine (so J-2-SL, J-2S-SL, or

RL20-P3-booster in BDB.) During the preparation of the study, they only used the Standard J-2 with a Sea level optimized bell. Carrying 0 M55s the payload to LEO was a small but not insignificant 5,500kg. Running in an 8x4 array of 12 M55s the payload could rise to a hefty 34,200kg. In this way the INT-19 was a more direct replacement for the Saturn I and the INT-18 before it was a more "between" the Saturn I and the Saturn V. While not currently in the game, although work is being done to bring it onboard, the M55 can be almost replicated by using the 0.9375m Algol SRB from BDB.

The Saturn V derived INT-20 is a unique look at a company's study done almost out of spite for a competing company. The S-IC(C5) rocket stage is vastly overpowered for LEO only launches… At a heavy and in-efficient 4.6gs of acceleration, in conjunction with a MS-IVB upper stage, the S-IC can hurl 72,000kg to LEO…. Conversely, if you remove all but 2 of the F-1 engines it can lift a stately 27,000kg to LEO… still at the still heavy acceleration of 4.6x the force of gravity. Where it gets mind numbing is when you reduce the S-IC's fuel load allowing for a peak acceleration of 6x the force of gravity… 133,000kg to LEO… In short, the INT-20 is not a real workable design since most spacecraft have a hard limit of 4.0x the force of gravity.

The INT-21, the only member of the entire MLV family to fly, is Unique in that while it too has a 4.68x G acceleration like the INT-20 before it, it does not seem to be made from spite like it's predecessor. Utilizing a standard sized but optimized MS-IC(C-5) first stage and MS-II(C-5) second stage the INT-21 was poised to be THE large mass launcher for the US space flight. In the end a somewhat related standard Saturn V was used to launch Skylab… Like the INT-18 and INT-19 above, and to a lesser extent the INT-20, the INT-21 studied "basically standard" tankage from the Saturn V equipped with less engines. With 4 F-1s and 3 J-2s the INT-21 was capable of 76,000kg to Leo. With a full 5x5, 116,000kg to LEO.

INT-21 configurations

Designation	Mass to LEO
Saturn INT-21(4x3)	76,000
Saturn INT-21(4x4)	84,000
Saturn INT-21(4x5)	89,000
Saturn INT-21(5x3)	101,000
Saturn INT-21(5x4)	112,000
Saturn INT-21(5x5)	116,000

INT-27 the last of the LEO designs published:

The INT-27 is not really buildable in KSP. It utilized 156" SRMs that do not exist (sure that is a 2.5m solid like the space shuttle SRB but the configuration of the parts requires a different shape to fit in the Saturn setup. The idea is strikingly similar to the INT-16 above and the drawings for it are oftentimes confused with the INT-16. In the INT-27, a single CTD-156 SRM would be centered under an X Truss that is below the S-IVB(C1) to S-IB(C1) interstage. Then four more CTD-156 SRMs would be radially attached to the central one… like the INT-16 the SRMs would burn "outside-in" with the single in the center being the 2nd stage. The problems start with the fact that United Aircraft Chemical Systems division (the manufacture of the UA-120x for Titan) never solved many of the issues with their 156" SRM. Most MLV documents assumed they would be functional. Instead, Thiokol and Lockheed would both solve the problems of nozzle gimbal nearly simultaneously. The result was Thiokol's 156" SRM being chosen as the basis of the Space Shuttle 148" SRB. In theory, the combination of CTD-156 SRMs would have lofted between 18,000kg and 70,000kg to LEO.

Here ends the role-call for all the Saturn Derived Saturn I replacements at the end of the 1960s. A further series of studies were done for NASA in the 1970s but most of that was focused on technology growth rather than actual all-up rockets.