America's *Other* Rocket Program

By Edward B. Driscoll, Jr.

Baby, it's cold out! And it's 6:30 in the &#*@%# morning! Oh, and did I mention we're in the middle of nowhere - the Mojave Desert in California?

But, on this bleary December 2nd 2000 Saturday morning, we're here for a good reason. We're here to watch rockets launch. We're at America's "other" rocket launch facility, the Reaction Research Society's test site, used by its 350 or so members.

Think of the RRS as a miniature version of Tom Wolfe's *The Right Stuff*. Their launch facility has the same California high desert setting. In fact, it's directly south of Edwards Air Force Base. It has the same concrete cinder-block lean-to Godforsaken out in the middle of absolutely nowhere atmosphere that Wolfe described. It has the same feeling of men taking basic technology to its absolute limit. Yeager isn't here, and there are no X-1s or manned rockets, but that pioneering, on the edge of space, do-it-yourself, rugged individualism is omnipresent. It may be on a slightly more modest scale, but The Right Stuff is here in spades--but of course!

These Aren't Estes Models

The cars pull in from about 6:30 in the morning until about 10:00 a.m. "Park over there, with your windshield AWAY from the launchpad." Gee, I hope my car insurance covers the odd liquid hydrogen explosion. The launchpad already has two rockets on it, a 15' foot high black solid fuel rocket, and an even taller red and white liquid fueled rocket that looks like an enormous Estes model rocket.

But these are not model kits. They may not be on the size of an Atlas or Titan missile, but these are serious rockets, custom built the same way a Savile Row tailor makes a suit--very slowly, by hand, and with loving attention to detail.

Dave Crisalli, the president of the RRS describes rocketry as basically having several stages (pardon the obvious and regrettable pun). The first stage are the Estes rockets that everyone had as a kid, and may still enjoy today. "And the next step up from that is what they call high-powered model rocketry, and those are the bigger ones," Crisalli says. "But it's mostly, you buy the motors from somebody, and you buy the kits to put the vehicle together from somebody, and most of that is the fun of flying it, and putting the vehicle together."

"In amateur experimental rocketry", Crisalli says, "the whole purpose of it is the design and build the propulsion system itself from scratch, whether it's a solid, or liquid or a hybrid kind of system."

Reading the Riot Act

Behind the launch pads, there's a registration building that's the same sort of Quonset hut that Gomer Pyle would feel right at home in. Inside, a rocket with a surplus Atlas steering motor is being prepped for launch.

To the left of the launch pads is a three story static test rig which Chuck Yeager or Scott Crossfield would probably have flashbacks to when they static tested their X-1 and X-15 engines.

At about 10:00 a.m., Dave Crisalli, the president of the RRS reads the attendees the riot act. He tells them where its safe to stand during the launch (very, very far away from the launch pad, or under a 12 inch thick concrete ceiling open walled semi-underground bunker many feet away from the launch pad). He tells them that he needs to get FAA approval as to when he can launch each rocket, lest a rocket and 747 have intimate contact with each other. And he explains he also needs to coordinate with Edwards so we don't interfere with whatever secret stuff they are doing today.

Everybody there has already signed a release form that reads in part:

Disclaimer: I the undersigned, by my action in joining the Reaction Research Society, agree to indemnify and hold harmless the Reaction Research Society, its appointed pyrotechnic operators, each of its members, officers and agents from and against all claims, damages or injuries direct or consequential arising out of any participation in activities associated with rocket test operation. I understand the potential hazards involved with rocket launch and static test activities. I also recognize that violations or non-compliance with the directions (pertaining to safety) of the Pyrotechnic Operator in charge of any particular event may result in suspension of my participation in firing events.

Oh swell. Nothing like worrying about a liquid fueled rocket capable of Mach four and a 50,000-foot altitude landing on your head.

As the weather warms up, (and boy, does the desert have huge temperature swings or what?), the jackets and sweaters come off. A scattering of Boeing and Rocketdyne T-shirts can be found, as well as some guy in a strange combination of corduroy pants, suspenders and a white Panama Optimo hat, with *Nuts & Volts* just under his name on the "Hi, My Name Is" sticker stuck to his shirt pocket.

The Boeing and Rocketdyne T-shirts are evidence that several of the members of the Reaction Research Society aren't just weekend warriors, but actively involved in the nation's Government funded space programs. (We'll look at America's burgeoning commercial space efforts next month.)

But most of the members of the RRS are normal white-collar professionals, whose hobby just happens to be amateur experimental rocketry. “It would be difficult for me to pick a typical member, Dave Crisalli says. “We have people who work for UPS, we have machinists, we have MDs, we have a couple of attorneys. We really have a very wide gamut of people interested in it.”

Of course, most RRS members don’t work in the aerospace business as a profession. One thirty-year member was a facilities plant manager for LAX airport for many years. Another member ran the water analysis chem lab for the Los Angeles Water District. And a current member is the president of Massively Parallel Instruments Inc., a company dealing in leading edge ion processing technology.

At Mojave, the majority of RRS members head towards the open-walled bunker in anticipation of the first launch, the black solid fuel rocket. A few go much further out, where it’s supposedly safe to stand out in the open.

The RRS has an excellent mega-watt PA system for the countdown. FIVE. FOUR. THREE. TWO. ONE. WHOOOOOOOOOOOOOOOOOOOOSH!!!!!!!!!!!!!!!! The solid fuel rocket tear-asses off the pad, leaving a similar trail of smoke as the solid rocket boosters of NASA’s Space Shuttle leave, and reaching close to the 50,000 foot limit that the RRS and the FAA agreed to. I’m later told that this particular rocket was carrying a payload of 75 pounds of steel ballast in it, just to keep it under that 50,000-foot limit

After several seconds of flight, the solid fuel rocket eventually crashes to earth somewhere out in the desert, proving why the RRS likes having many miles of desert between them and civilization.

The RRS’s Wartime Birth

The solid fueled rocket is typical of the rockets launched by RRS since it was founded in 1943. Back then, America was in the midst of a Second World War dominated by weird new rockets being dumped on London by a Teutonic totalitarian madman. Would the U.S. be next?

Of course, in World War II, Germany was beyond American rocket technology, but their space program had similar humble origins in clubs of dedicated amateurs. In the U.S., prior to the RRS, sure there was that Robert Goddard fellow, but he was largely a footnote, until the U.S. military saw what a simple rocket could do when mated with an explosive payload.

With V-1s and V-2s in the news everyday, in 1943, five or six high school kids living in Glendale, California decide they wanted to learn more about this new technology. Surely it could have peaceful experimental and exploratory aspects, as well as its obvious destructive power. The Glendale Rocket Club was formed. Soon, its name was changed to the Reaction Research Society.

“They started to build solid and liquid rockets, and actually had a very wide range of unusual projects,” Dave Crisalli says. The two kids that did the most were a guy named David Elliot and Lee Rosenthal. Elliot still works at the Jet Propulsion Laboratory in Pasadena. And they built a hydrogen peroxide mono-propellant rocket, which was very sophisticated for the time (1948-1949), while they were high school juniors and seniors. They launched it in 1950 while both of them were freshmen at Cal-Tech

“The Society kind of blossomed through the late 40s and into the early 50s. And I think it probably hovered all through the 50s at anywhere from 50 to 150 members--it kind of fluctuated up and down there for a while.”

Mojave is not the first test site that the RRS had. The first was located between Lancaster and Mojave. The RRS used it from their inception until about 1955, when Lancaster had expanded enough to where the RRS risked having a rocket land in someone's backyard. So they went out to Mojave and they bought that piece of property in 1955, and they've been out there ever since.

Building Rockets 101

Nick Kirchner, the president of Massively Parallel Instruments Inc. (MPIi), says, "For the most part, there aren't any custom parts available for building these rockets, so it becomes an educational exercise, along the lines of 'how can I do very complicated things, with parts I can purchase commercially, inexpensively. How can I do this kind of thing with stuff I can get at the hardware store or stuff I can buy at Home Depot?'"

"As opposed to doing a very complicated thing," Crisalli adds, "like NASA does, with something that's specially designed for it that costs a million dollars apiece. Because I'm funding a rocket out of my own pocket now, I need to make it work for ten dollars. So you have to able to know enough about the engineering that goes into this, or go get help from somebody who does, to start to piece together the puzzle."

For example, if someone wanted to build a liquid rocket, they would have to pick an appropriate thrust level, whether it's a hundred pounds, or a thousand pounds of thrust, or anywhere in between. Next, a propellant combination would be needed that could handle that. The rockets launched by the RRS in December included rockets fueled by solid fuels, liquid oxygen and alcohol, liquid oxygen and kerosene, and even superheated water, i.e. steam.

One source of surplus rocket parts that Kirchner recommends is Norton Sales, Inc. of North Hollywood, CA. (http://www.nortonsalesinc.com/). Need a spare Atlas or Titan missile engine? How 'bout a World War II Messerschmitt ME-163 rocket plane engine? Norton is the place to go. Kirchner himself is using a spare Atlas steering engine to power the rocket that he's building in his garage.

All In A Day's Work

That same type of Atlas engine powered a large liquid fueled rocket sponsored by Flometrics Inc. of Solana Beach, Calif. during the December launches.

Unfortunately, the handsome white Flometrics rocket didn't have a good weekend. Fueled by liquid oxygen and kerosene, it unfortunately, "burned up on the launch rail", Crisalli says.

Which illustrates a couple of the risks of amateur rocketry. One is that occasionally, things go BOOM! on the pad. The other (and more frequent) risk is that landing mechanisms don't work. Crisalli says, "we always joke around about recovery systems in amateur rockets, (and it's true for professional rockets, by the way), 'the primary system might be the parachute, but the back-up system's always a pick and shovel--and the backup system is the one that usually gets utilized.'"

Launching 'em, landing 'em and occasionally crashing 'em: it's all in a day's work for the members of the RRS--America's other rocket program.

Sidebar: Joining the Rocket Program

Ed: Dave, I'm writing this thing for *Nuts & Volts*, and I know somebody's going to read this thing and think, 'hey! I want to do this!'

Dave Crisalli: Yeah! Well, probably, the best thing to do then, is just to get back issues of the *RRS News*, because the issues that we've put in the past four or five years have been pretty good, as far as technical detail is concerned. And there are very good articles in there about solid propulsion stuff, several articles on liquid propellants, and hybrid propellants, where you use a solid fuel, and a liquid oxidizer.

But other than that, the only other reference material I've ever found, that was at all useful, was to go back into the Cal Tech papers, and reports from the late '40s and early 1950s, because, although Aerojet was just starting up at the time, and Rocketdyne was just starting up, and although they were the professional people at the time, they were doing it in a very amateurish fashion, compared to today's standards. So the initial things that they attempted to do are probably the most instructive information around for modern amateur guys.

Ed: So how does someone join the RRS? I know the Web site is at http://www.rrs.org/, but how much does it cost to join?

DC: Membership is $35 a year for Associate Membership, and it's $30 a year for Corresponding Membership. Mostly, they just get connected to other like-minded individuals who are interested in the same sorts of projects. The $35 a year basically covers the cost of printing a newsletter that we make every attempt to put out four times a year.

You also get access to the facility out there [in Mojave]. If they don't know anything about what they're doing, if they just have an interest in it, they can find other people who *do* know what's going on, and will help them through getting the materials and making the parts, and doing the calculations, and that sort of thing. Then of course, they can bring their rocket out to the test site, and either static test it, or flight-test it, or both, which is often the case with the more complicated projects. And basically, the RRS is an educational group, and it's an exercise in very intense self-education.

Ed: Speaking of self-education, do you have manuals or reports or, something like *Building Rockets for Dummies*?

DC: There are some books out there-- but not many. There's a genuine dearth of information for the hands-on guy. There's a lot of very technical theoretical stuff. In fact, the best reference for liquid-fuel rockets is a book by a guy named George Sutton, and it's called *Rocket Propulsion Elements*, and it's been used as a textbook for many years for teaching basic rocket theory. But it uses professional engines as examples, and it goes through some sample calculations, but it really doesn't say, 'Gee, if you wanted build one of these in your garage, this is the way that you would do that.' And to my knowledge, there aren't any publications like that.

The technical journal that we put out, that we call the *RRS News*, is probably the only thing that I've ever seen published, and it's because we publish it, that explains people's projects after the fact. That says, 'here's what somebody's doing. Here's how he built the engine, and here's how the components came together, and here's the calculations that you need to do if you want to make it slightly bigger or smaller than the one in the example here.'