AeroElectric Occasional

GMCJetpilot: "No offense to Bob, but OV relays are a step backwards."

January 26, 2007

For some years the AeroElectric List has been host to some conversations involving one "GMCJetpilot" who claims a great deal of knowledge, experience and understandir but who has yet to demonstrate it. He has consumed hours of everyone's time in attempts to get down to the science of applying our art to a practical world. Some months ago he was politely asked to take his disruptions to somebody else's classrc For a time, purposeful decorum was restored.

However, it seems that George's hot-button is supported by a faith in the marketing hype for internally regulated alternators wherein he has demonstrated no first-hanc understanding of their design and has brushed aside design goals of individuals who do not share his faith.

This has been a trying experience made more difficult by the fact that we don't eve know who this fellow is. Everyone else on the AeroElectric List participates under the bright illumination of disclosure: "Here's who I am, here's what I'm about and here's how I'd like to work together to increase understanding." George chooses to at the edge of the sandbox and throw sand while hiding behind his pseudonym.

Since George has resumed this behavior a few days ago, I thought it would be useful for newcomers to the List to have some understanding of what we've already been through with George. What follows is a SMALL excerpt of the hours of conversations I've expended with George's circular arguments and intractable ignorance.

At 09:00 PM 8/7/2005 -0700, you wrote:
AeroElectric-List message posted by:

From: "Robert L. Nuckolls, III" nuckollsr@cox.net

Subject: Real data on Over Voltage Protection and Control of Internally Regulated Alternators.

It depends on your paradigm

That was my whole point. Bob you are focused on one small aspect. Aviation safety is a much broader subject than voltage regulators.

I'm sorry, we WERE speaking about voltage regulators, are there other aspects of aviation safety we should be considering for this discussion as well? For the past

> ***70+ years, folks flying airplanes have had switches on the panel that offer (1) absolute control over all sources of power in the aircraft and (2) has a remote probability of a failure that propagates across multiple systems. The FAA requires that I work within that paradigm when offering up new systems for certification. My customers are pretty happy with that model too.***

You missed the point. Opinion does guide your perspective. I don't worry what the FAA says.

> ***The above at least was not opinion or perspective. It was a statement of simple fact. I'm not saying that you SHOULD worry about what the FAA says, but I will suggest that not everything the FAA says is BS . . . there are some useful ideas to be gleaned from FAA positions on system design and operation. I only mentioned it because the FAA is one of many participants who drive my design goals.***
>
> ***I'm completely mystified by your statement. How does the fact that the FAA will or will not bless any particular reasoning make it an automatic no-brainer for someone building his own airplane? This isn't about regulations or opinions, it's about design goals that satisfy the paradigm under which the owner/operator of the end product. 99+ percent of OBAM airplane builders are comfortable with and most understand the paradigm that controls how certified airplanes operate.***

Bob don't be mystified. That is so condescending. What I wrote was so bewildering, you became disoriented and confused? Wow I did not know my words had the power to mystify. No one is proposing a panacea here Bob and were ae a lot smarter than you give us credit for.

> ***It's condescending to admit a lack of understanding on my part? What word would you have me use?***
>
> ***Do you have data about how the various IR alternators operate such that you can DEMONSTRATE that anything with ND's name on it will operate in the paradigm that applies to the vast majority of airplanes flying? If not, then your recommendation is not backed up by demonstrable, consistent behavior and is in fact, preference for a different taste in your bowl of stew.***

Do I have data? Bob, that is an inane thing to ask. There are 148 models of ND alternators with internal regulators and internal fans ranging from 30 to 130 amps. There are 66 models of ND alternators with external regulators and internal fans from 90 to 136 amps. Plus there are another 15 various models with external fan models. There are a few million ND alternators in daily use, 24 hours a day, every day of the year working with excellent performance and reliability. If this does not prove, demonstrable and consistent performance characteristics, to BAD. All your posturing is absurd. You seem to lack common sense and reasonable rational. These are experimental planes. If you have never been in one, there is a warning placard that informs passengers that an experimental airplane does not meet standard aircraft certification standards. Bob, I never said my recommendation was a substitute, replacement or better than your brilliant concepts, architecture and philosophies.

Forgive me, the DATA I was referring was about schematics and/or operational characteristics for any internal regulator that would offer a system designer exactly how his/her choice of alternator would behave under command and control of small wire coming out the back? Further, what are the failure modes for the regulator itself? The same data would be necessary for you, me or anyone else to deduce failure modes and operational characteristics under those failures and how we might (or don't need to) deal with it.

I've stipulated many times before that the fleet of IR alternators have an exemplary track record . . . as do the B&C alternators.

None-the-less, folks continue to come forward with their failure experiences. Not a "current generation ND alternator? Don't know. Not a stock regulator? Don't know. Would a well considered ov protection system of ANY flavor have saved the day? Probably . . . likelihood of dual failures in same system on same flight are extremely rare. At least one customer with the b-lead contactor and OVM-14 crowbar module has written to me expressing relief that the system was in place when his IR alternator went tits up.

Bob, I am glad people write you to relive themselves. I think part of that relief i from all the misinformation and rumors about IR alternators you spread.

You mystify me again sir. You brush aside first-hand alternator failure experienc with myself and others on the List as figments of their imaginations brought on my my nighmarish mis-information and rumors?

I have all my statements about internally regulated alternators in the archives. Please give me specific statements that you are characterizing as rumor or misinformation. If I have been incorrect in any way, it was an error which I wil be pleased to correct. Please cite any instance. I'll look it up, rectify the misconceptions and add it to the appendix of this posting.

With all the sensationalized talk it is easy to see how someone could have an unrea heightened sense of concern. What folks continue to come forward? You are the maste of inflammatory insinuation.

I believe in precise speech. I never insinuate anything. I strive to communicate in simple-ideas (fundamental truths). The fact that you've become inflamed over anything I've written is unfortunate and not my intent but also not my problem. Please don't paint me as having any kind of under-the-table, ulterior motives or agendas. It's simply not true.

How many accidents have been caused by an OV and did they involve a ND alternator? ZERO. You have a better chance of your 0-2 gage-battery cable grounding, burning thru the engine mount or just falling off. Electrical system failure is a very small % of the total GA accidents. Statistically, regardless of where you put the regulator or if you use a crow bar or not, your accident statistics will not change

How did accident rates get into this discussion? I don't recall ever having suggested that this discussion has a thing to do with accident reduction.

It's about doing a simple task assigned to things like circuit breakers. A breaker keeps the wire it feed from catching fire. It also isolates a failed branch in the system from propagating it's failure to other components

of the system.

Since the ALERNATORS holds great potential for an energy intense failure. It's perfectly reasonable. It's the ONLY device in the airplane that will boost bus voltage beyond levels ALL other accessories will withstand. I've never read of an accident where lack of ov protection figured in the chain of events. Howe there have been many instances where the OV event has needlessly damaged other o system components at great expense.

But do you agree that the risk is not zero? In fact, one of our brothers here on the list reported such an incident recently. If I were trying to convince someone of anything, I could have wished that Jack's failure would have occurred two hours out, at night, over mountains and took out a bunch of radios to boot. When one is looking for propaganda fodder, the sweat-drenched, nail-biting stories are much more useful. Gee Jack, you let us down. All you\ lost was a fuel level indicator!

Bob that is just more emotional sensationalized comment is not worthy of an engine that you claim you are. You are clueless, I mean ignorant to the meaning of incide This is what a pilot would do Bob: Over the mountains you loose your alternator; T off all your non-essential electrical stuff and continue to fly. You pull the ALT circuit breaker and the B-lead breaker. When you get near your alternate (nearest suitable airport) you turn the electrical stuff back on and land. Modern avionics like GPS pull a few 1/10th of an amp, so you could run on BAT power for a while. Nighttime you should have a flashlight. If you have a glass cockpit you should have enough battery power for at least 30-45min VFR and an hour plus for IFR. If you al have electronic ignition and fuel injection, all electronic you would need a bigge back-up battery. Dual alternators?

My personality flaws not withstanding, this was an attempt at a bit of humor . . . I WAS admitting to the increased propaganda value of spectacular failure stories and lamenting the fact that if I WERE operating in a mode of exploiting people's unhappy events, it was too bad that Jack's story didn't have more "red meat" in it.

You propose to lecture me on system reliability using words that suggest you've never read Chapter 17 of the 'Connection. Do you have a copy by the way? If not, shoot me an address and I'll send you one at no charge. If there are errors in Chapter 17, please be specific as to what needs modification.

My viewpoint is use a Lycoming with a mechanical fuel pump, at least one magneto o P-mag. A carburetor or mechanical FI does not need electrical power either. The D GRT-EIS-4000, Garmin and other misc items are pulling about 5 amps total. The Dynon and GPS have self-contained batteries as well. My engine is electrically independent as I feel it should be. I understand fault tolerance Sir.

Agreed. Sounds like this stuff would run from an e-bus very nicely. You absolutely missed the point. Again, this has nothing to do with how much this system would please or displease me, the FAA or anyone else. It has everything to do with operating within the paradigm (which the FAA happens to like - as do the vast majority of OBAM aircraft builders).

Bob, no you missed the point again. /Operating within the paradigm/ is gibberish that has no practical meaning to anyone. Common sense is the paradigm Bob. If you can't dazzle-em with facts, baffle-em with the word paradigm.

Forgive me please . . . choose a phrase more to your liking. How about "design philosophy" or "design goal" . . . I like "paradigm" because it takes fewer keystrokes but if you believe I'm trying to dazzle anyone with meaningless gibberish, I'll not use it any more.

It is not an affront to you or any device you have worked on. I have studied your every word and understand it. I just don't want a device that SHORTS to ground to w matter how clever or certified it is.

Why was it not sufficient to cite that design goal at the outset and work toward an alternative configuration that satisfied your desire? Both you and Paul seemed to need some justification for offering alternatives that depended on demonizing the crowbar OV protection system. When I set out to do the crowbar system 25 years ago, there were design goals that avoided some pitfalls and expenses of current technologies. I didn't need to promote the idea based on hammering the work of those who went before me, it was sufficient to offer the new idea and explain how it helped me eliminate some problems.

I don't really care what the FAA thinks as long as I get my paper work signed. It i my butt and for a VFR plane, with no main buss electrical dependency to stay in the air, I am safe. What else can I say? What don't you understand? I designed my syste to eliminate the need for a crow bar and external regulator. From personal experien with a ND alternator in my cars and plane, I expect over 4000 hours of operation before failure (200,000miles & 12 car years). So when my alternator reaches 2000 hours or 8 years I will remove and replace it.

Very good. You've illustrated your design goals quite well. May I offer another feature worthy of consideration? When you use a breaker to open the b-lead of a runaway alternator, at the time the contacts first part, the breaker will already be several hundred milliseconds into a warm-up cycle in anticipation of opening the circuit.

As the contacts first break, the very tightly wound "spring" in the form of a 50-70 amp pull-up on bus voltage will build the voltage across the opening gap very quickly. Peak voltages to be considered are at least 100 and probably pushing 200 volts.

If the arc does not go out, then in seconds following breaker operation, you'll have something in excess of 5,000 watts of heat being dumped into the interior of the breaker. Being a molded plastic part, there is risk that it will begin to change shape rather quickly and with lots of smoke to boot.
Click here for an example of high current contact failure in a non-metalic enc

While wrestling with the IR alternator control issue, I favored the control of b-lead circuitry OUTSIDE the cockpit and by means of a system mostly enclosed by a metal housing with as shown in this picture.

I've been working an issue on some certified airplanes where breaker failures hav put smoke into the cockpit. We have to take these things very seriously not only because of the operational aspects of upsetting a pilot but because of the nature of DC power systems where established arcs are difficult to put out, dump out a l of energy and are not well contained in a plastic housing.

> ***You remind me of individuals who have a lot of opinions about a book they've neve read. The crowbar OV protection system IS certified sir, several times over. I'v stated this numerous times in this thread. All of B&C'S many STC'd installations both belt and pad driven alternators use the LR/SB series regulators all of whicl have crowbar ov protection.***

I must remind you of yourself, since you talk about stuff you are clueless all the
When the guy with the Subaru had the electrical failure you pontificated and critic
with little knowledge of facts.

> ***Hmmm . . . I don't recall the specifics, what was it I said that was so baseless in fact? Please point me to some linkage that I can review. I'll be pleased to revisit any assertions I might have made.***

When you stated how B&C starters are better than Sky Tec with bushings and blaa bla
The SkyTec guy put you in your place.

> ***Forgive me, but this now seems to be more about let's shoot Nuckolls off his perch than about science or considering the tradeoffs in design goals. How does SkyTec figure into this discussion? But if you want to add SkyTec to the discussi you'll need to give me linkages to the words in question.***

You should have apologized but you replied with something stupid comment about lets

> ***I don't recall the conversation now. I'll look back through my OutBox and see if I can snag it. But as I suggested to Paul, repeatable testing and sharing of data gathered is a courtesy that engineers and scientists afford each other with a goa of accurate communication of fact and lucid interpretation of results from which good decisions are made. I will apologize for mis-statements of fact and behavior that does not reflect my goal of conducting myself in honorable ways but you're going to have to be specific. I'm not going to launch into any big researc projects over this discussion.***

Again you did not have the facts. I am not perfect but you are ignorant.

> ***I agree that certification is not the Holy Grail of function or performance and wasn't using it as such. You offered lack of certification as a useful data point when considering B&C's products, I was only attempting to update your mis-conception. The "book you did not read" was a collection of B&C's data sheets that accurately disclose their achievements in the suite of products offered to aviation.***

You also remind me of someone who loves to argue.

> ***There's a very accurate perception. As both engineer and teacher I am duty bound to argue in favor of accurate critical review using good science and honorable be with respect to my fellow workers and my customers. Since I do very much enjoy th profession, it stands to reason that this discussion could be exhilarating. You d not seem to share this perspective which is disappointing. I'm not doing this to "shoot you off any perch."***

I see B&C has a standby alternator system for the Bonanza and C210. Good for B&C. S
not up to date. Sue me. Apologies.

Lawyers give me allergies. I'll pass on your suggestion but if you must apologize, I accept.

Do they have any STCs to replace the main alternator on any plane? If no, then why?

Easy, they have one overworked, under paid guy doing ALL of their STC's. He is peddling as fast as he can to produce results on the tasks before him. Bill has elected to attack the standby alternator market first and seems to have made a good penetration. As a matter of fact, Tim is currently working on an STC to put the L-40/LR-3 combo on Super Cubs . . . the very same installation featured in all the kerfuffle with the FAA back in '97.

If you would like an STC for your aircraft, give them a call. It's probably somev on Tim's long list of things to do.

(Since this the original writing, B&C has acquired some STC's to install the L-series alternators and LR/SB-series regulators [all fitted with crowbar ov protection systems] on type certificated aircraft)

You couldn't offend me if you tried. I won't permit it. You do amaze me with your lack of understanding as to what the real issues . . .

There you go again. What does that mean, I WILL NOT ALLOW IT. Whatever Bob. I was making a sincere jester of concern and you throw it back at me as if I was inconsequential and beneath you. I understand I am not worthy and of no importance

It's quite simple. Nobody can offend you unless you allow it. If individuals offer language citing facts and conduct rational debate, then there is no reason for anyone be offended. If the language contains words designed to hurt or to propagate un-truths, then one may CHOOSE to be offended or to take passive notice. I have only so much emotional capital to invest in my relationships with people. Therefore, expenditure capital on being offended is a poor utilization of a limited resource. I choose instead to take a non-taxing notice of most ignorant or vindictive behaviors.

The issue before us isn't about ov protection. It's about control. Does your ND alternator of choice turn ON and OFF at the flip of a switch? Once it's in operation, can it be turned OFF? Do all alternators with the ND brand on them operate in this manner? How does one insure at the parts counter that the alternator being considered will operate under the currently accepted design goals?

Engineers? Bob you can't control everything, you only think you can.

Say again? When my boss gives me a design goal that says "control this" I will either (1) control it or (2) explain to him in very lucid terms why it cannot or should not be controlled.

I can't think of a reason why I would turn off a perfectly good alternator with the engine running. If it did crap out I would pull the B-lead CB in my panel.

That would essentially isolate it from the electrical system. (Yes I want control of my B-lead and opt NOT to use a FUSE under the cowl where I can't access it, as you suggest.) If I did not have the CB for the B-lead I could shut the BATT master off. The engine would continue to run. The Dynon and GPS would be powered by internal batteries.

> ***When there's smoke in the cockpit, one usually wants to shut off every electrical power source. If an alternator fails a diode, it may generate a lot of noise that prevents utilization of radios battery-only. If you have two alternators (Figure Z-13 for example) you want to shut down the main alternator to preflight the standby alternator. Figure Z-12 is installed in many Bonanzas. We shut down the main alternator to see the standby machine pick up the load. There are probably others.***
>
> ***If you never have a need to shut the alternator off from the panel, then then you're proposing a new DESIGN GOAL. Which is fine . . . but be prepared to explain it in sufficient detail that everyone knows the physics upon which your recommendations are based . . . and they understand and accept the new DESIGN GOAL. This has nothing to do with opinions, only facts and customer perceptions of value in the proposed DESIGN GOAL.***

I don't have customers. I am an individual and have stated so. As I clearly stated your paradigm (oh I hate that word) is valid and needed based on your position as guru. I dont have to prove anything. I have been honest in saying that ND alternat have gained over a thousand of hours on single airframes. Personally 800 hours of N time in a plane and a total of approx 6000 hours in three automobiles (with ND alternators). As for the auto applications, the highway safety foundation has never had a problem with ND alternators, which is not true of many other alternators. Since records are not kept for experimental fleet, I am going by my experience and those of other RVs (some with 2000 hours) over 15 years. Not real scientific but it works.

> ***Then why are we having this discussion? It was my understanding that when we started this List, it was to be a forum for the gathering and sifting of new and old ideas looking for ways they can be assembled in more useful ways. It's also a forum for helping the neophyte builder take advantage of these ideas from the perspective of understanding rather than "buy these parts, hook 'em up like this and TRUST ME, it will work."***
>
> ***We've already explored several reasons why the pilot wants to have control over ALL his alternators but none of these are drivers for your design. Given all the in-bound cabbages and tomatoes about designs I WAS trying to perfect I presumed you had an alternative configuration to sell, academically if not financially.***
>
> ***You and Paul have alternatives with no relationship to configurations other folks are considering and I'm trying to help evolve. I've offered space for additional Z-figures in the 'Connection to illustrate your concepts . . . but if I understand what you're describing now, it's classic C-172 except for an internally regulated alternator that must be controlled by pulling the b-lead breaker. This is the essence of the last drawings I saw from Van's and I'm not interested in offering up slightly modified C-172 systems as exemplary advancements of our craft. If it fits your needs, that't fine too. You don't even need to defend it UNLESS you're on an intellectual selling mission in the***

world of ideas.

Chance-Taker? Bob you have such a PIN HOLE view of the world , aviation and aviatic
safety, or at least you sound like it. I am bewildered and confounded by your very
ignorant words. I am dizzy with disbelief. You dont know me and I am a very
conservative ATP. This is just another feeble insult and a smoke screen for the lac
of an intelligent comment with substance. I dont know what is romantic Sir, but I
read what builders want to do. It is clear they are trying to make it perfect of
totally fail-safe. Which is impossible with any of your suggestions or paradigm.
If you like I will explain how an air transport category planes electrical system
works to illustrate how unsophisticated our little DC electrical systems are.

Sure, we all take chances every time we pull out of the driveway in our cars or break ground at takeoff. Did you climb into a car and go without some instruction? An airplane? Did you launch into an airplane construction project without surveying the terrain ahead?

This would be amusing if it weren't so serious. In one breath you extol the virtues of a "brand new" ND alternator while in the next, you cite the value of de-rating to 30 amps, supplying cooling air, modifying operating techniques that don't bother the alternator on a C-172 but might be stressful on the brand new ND . . .

Well Bob, for someone who claims to know how an alternator works, you appear to hav
a lack of any comprehension. I am not extolling any more than you are singing about
the 7th wonder of the world called a Crowbar. WHAT DO YOU MEAN?

First, I've never held the crowbar system up as anything miraculous, it is simply what it is. One of several ways to deal with a runaway but controllable alternator. If you wish to use other means, I couldn't care less. The only reason the crowbar design is even a part of the current discussion is because you and others have erroneously or maliciously drawn it into the discussion and compelled me to defend it. Now, in the act of defending it you accuse me further of raising it to celestial stature. I guess my defense must have been effective. If you can't "get me" on the science, then let's go after some imagined marketing hype.

The point of the comment about cooling/derating was in reference to your willingness to accommodate the ND machines vulnerabilities to it's own load dump spike by never expecting to control it. Then followed up with more concessions for cooling and de-rating. Yes, we do cool alternators and generators, and sometimes de-rate them. Based on load analysis, hot climb cooling tests, etc. But with reason dictated by tests and numbers, not as an off-hand recommendation intended to assist the neophyte builder. All-in-all, not an encouraging thing for a new builder to ponder.

You cite facts not in evidence. The LR series regulators were tuned to provide the slightly under-damped servo response for step functions in both command and load. It's a classic task for tailoring servo response. If the internal regulator were so whippy, LOAD DUMP ISSUES WOULD NOT EXIST. It's a regulator's

inability to control the worst case load reduction that causes the high energy voltage transient.

You cite facts not in evidence? Bob, what the heck do you mean? Whimpy? What kind o engineering term is that? That is how they work by design.

Yes, you're exactly right. By the way the word I used was "whippy" not "whimpy". What we see is what we get.

The internal regulators are optimized for performance under normal operating conditions with a battery in place. Since the internal regulator is NOT a mathematical engine with advanced capabilities under guidance of software, it has very limited ability as a PID (position, integrating, differentiating) controller. The (D)ifferentiating functionality can be optimized for either the normal load or load dump events but not both. Hence, the effects we see in virtually all regulators, internal or external, under the load dump event.

"Whippy" was used to emphasize the inability of the simple circuit to mount so complex a task as dealing with both kinds of event. ND regulators don't do it, B&C regulators don't do it either. But don't need to in the case of controlling the alternator because the b-lead contactor is not necessary and no part of the system is at risk for turning the alternator on or off for any reason.

AGAIN FOR THE 10th TIME CUTTING THE B-LEAD OF AN IR ALTERNATOR IS NOT GOOD FOR THE ALTERNATOR. IF YOU WANT A CROW BAR USE AN ALTERNATOR WITH AN EXTERNAL REGULATOR, OR TAKE YOUR CHANCES WITH FAULTS CROW BAR TRIPS. GO AHEAD, USE A IR ALTERNATOR, IT IS WITH ME. EVERY ONE KNOWS RUNNING AN ALTERNATOR NOT CONNECTED TO A BATTERY IS BAD BA BAD. WHY IS THIS HARD TO GRASP BOB?

Never said it was. What I said was, If you need to control a failed IR alternator in the ov runaway mode, here's our best whack at doing it. This has nothing to do with ND, or any other brand of alternator and everything to do with a condition common to all internally regulated alternators. It's you who have raised the ND product line to celestial status . . . and I do not doubt that it's deserving of this recognition. But I'm not ready to recommend IR alternators if they happen to have "ND" embossed on the cooling cover. Too many questions of configuration management over which I have no knowledge or control.

Never said it was good. But there are folks who have stated this mode of operation as a DESIGN GOAL. For example, the electrical system in Bonanzas and Barons offer alternator only operations with separate switches for battery and alternator. In fact, we were given and ultimately complied with a design goal to provide a regulator that would not interfere with a Bonanza alternator's ability to come on line totally self excited. I don't like operating sans battery but that was the bosse's DESIGN GOAL and I complied with his directive.

Even today, once the standby alternator is installed, the POH calls out shutting the main alternator off to test the standby machine. A perfectly acceptable thing to do with alternators that can be controlled, not so good for those that cannot.

You claim to understand failure analysis. I doubt it. If you were driving your car

and the b-lead shorts (before the fuse), would you want the alternator to burn-out (fuse) or keep working and act like a welder and set the car on fire?

Your point is well taken . . . the potential for EITHER a properly working or failed alternator to output a LOT of destructive energy is great. I have offered questions to ponder that address this point. I'm sure there are others and this is the foundation for my suggestion that being able to break the field circuit from outside the alternator is the simplest, safest, most convenient way to manage any alternator working or failed.

(I have no idea what you will say, really, you would argue with a rock.).

Only rocks that talk and want to help people design airplanes. I've been doing failure mode effects analysis studies for my bosses for 30+ years. If I were so bad at it, I would think I should be attending a tool crib by now.

We know the OV trip caused the demise because after this event the alternator did not work anymore.

I'm lost, are you talking about the event reported to Van? The only one I'm aware of the builder stated that he cycled the ON/OFF control switch manually with the engine running and at some point, the alternator was damaged.

Without failure analysis data on the alternator, we don't know if the regulator went belly up in a passive or runaway modes. We can safely guess that the alternator's response to being switched ON/OFF manually produced SOME magnitude of a load-dump response. It seems reasonable to guess that failure of the regulator is attributable to the manual operation of the switch followed by what MIGHT have been a response on the part of the OV protection system to disconnect a runaway alternator. If you have any better data on this or any other instance, I'd be pleased to have it.

ND engineers no doubt assumed this would be a rare event (because they don't recommend OV cutouts by default. There are no OV relays in non-aircraft applicatior

I would hope ND's engineers assumed nothing. They should have delivered to design goals that fit their customer's needs with a high degree of reliability. I have no reason to suggest they didn't achieve those goals. ND's folks have probably never talked with my customers. It would be interesting to see what their recommendations might be for accommodating design goals unique to the aircraft world.

The IR has many functions and one of them looks at the B-lead. While under load it will assume a short or other fault, which it does monitor (because ND said so). Also the IC chip is connected to the B-lead and it just might be too much for it. SO WHAT. This is condition is avoidable. ND accepted this failure mode because

it is not suppose to happen and is safer than making a welder out of it.

I have no argument with their DESIGN GOALS nor with yours.

Bob I think you have IC envy. Yes Bob more transistor means more features and performance. You heard of computers? Well they have millions of transistors on a small chip. More transistors the faster it works. If you built a computer like you build your B&C VR, it would be the size of a house. I would think you could grasp that. The IC chips inside most modern alternators does have logic circuits (digital processes) and self-fault monitoring. DENSO will not send me the schematic to their proprietary IC design. What I do know about special IC chips is they are made by a handful of manufactures. They all seem to have similar features. Here is a typical IC spec data sheet.

That's a great chip. But it's a PID controller (or VID in the case of an alternator) with limited ability to deal with ALL cases of load transient. After this chip has been optimized for NORMAL operating conditions, it's ability to deal with the abnormal (load-dump) will be about as limited as with the earliest 2-transistor regulators (or B&C's transistors plus IC's design). Until someone goes the next step with a computing engine of some kind with the agility to sense and react to the non-normal, load-dump event. What we see today is about a good as it's going to get . . . now matter how many transistors they put on the chip.

Another interesting feature in this chip can be deduced by studying the fine print. It has OV WARNING but no OV CONTROL.

It's Eric's product as I recall, not Paul's. Further, it has nothing to do with nuisance tripping. It illustrates a means by which an IR alternator can be CONTROLLED irrespective of the reason for controlling it. OV protection is but one more layer on a system that's already several layers deep.

My mistake, yes it is another layer. I have read spec sheets on devices. If you must use a crow bar on an IR regulator it might be a good add on (another add on). It might help the OV relay from arcing as I think you and Paul have argued about.

I don't think we've had a single disagreement on the issues surrounding arcing at the disconnect relay. Similarly, I've suggested that you consider the same arcing phenomenon at your b-lead disconnect breaker. It's the same dragon to slay irrespective of the controlling technology.

You're entitled to accept any paradigm you wish. Just be sure your audience understands the paradigm shift when the proposed system does not operate like the one in a C-172.

Thank you for telling me I am entitled to an opinion. I don't need your permission to have an opinion but thanks. Let me make it simple for you, the engine should nev stop turning in flight. Most GA planes have engines with no reliance on external electrical power, or should.

This was in no way intended to be a granting of permission. I was erroneously belabored of the notion that you were trying to promote some new DESIGN GOALS for consideration by folks who frequent this List. Since you've made yourself clear on this point, I'm only offering this response as a courtesy of trying to clarify my position. Since you're only discussing your personal DESIGN GOALS then this is purely an academic discussion between us which others are free to use as they wish knowing that there are no new ideas to be considered as part of their own design deliberations.

That is a good thing and should be emulated at all cost . . .

Electrically free engines? It's not in the cards my friend.

. I understand Auto engines need power for the ignition/fuel injection and pumps. That is one reason why I would not use an auto engine. However an IR alternator could still be used, but you should have an isolated power source. You never considered a DC-DC converter (battery charger) to charge isolated battery. This is used on transport category planes.

Absolutely, I've written several white papers for start-up aircraft companies suggesting that they look into wild-frequency AC systems and used DC/DC converters for limited support of cranking batteries and avionics. All major power loads should run from the 208V/3-phase engine driven alternators. Wire sizes drop dramatically and system efficiencies go up too. Unfortunately, there are no wild-frequency generators or accessories suited to the light aircraft market . . . in fact, not for the light Biz Jet market either. But I'm watching this technology and MIGHT be encouraged to suggest consideration on this List at some future date.

Numerous folks have experienced failures of IR alternators. Some of them were ND alternators. Since we might expect to be in communication with perhaps 5% of the OBAM community, it's not a stretch to suggest that 3 hard failures I'm aware of over the past 8 years has been repeated 20X for the community at large.

Numerous? OK Bob what ever you say, Failures. Hard failures? You don't even know wh the word incident means. Like you asked me several times above, DO you have data? Prove it to me. You are throwing out numbers: 20 times, 3 to the power of perhaps? You are real loose with the numbers. What does that mean? What hard failure? What happened? I mean really Bob, you are hypocritical when you ask for data and expect to give none in return Sir. Other wise it is hearsay, innuendo and rumor. A few of these I tracked down where totally irrelevant and where factory planes with externa

regulators. Forget the Failure analysis Bull, how about some simple details. Basica WHAT HAPPENED? My I suggest if you had a smoking gun to support your view you would say so.

You're a relatively new kid on the List so you'll have to forgive me for assuming that you've been aware of failures discussed here. We have two, hard failures that produced damaged accessories in the aircraft and caused the builder to remove the alternators for repairs. One incident was reported recently by Jack, another was several years ago reported by Peter Graichen (sp?) and discussed on page 4 of this document.
The third was in either an e-mail or telephone conversation I had with a builder some time ago. His external b-lead control and ov protectior system operated as designed and saved him some grief. I don't know the brand or model of the first two events, only Jack's which he says was ND.

[I constructed this webpage many months ago but never published it. Since the original writing, numerous additional cases of IR alternator failure have been reported . . . George would brush these aside asserting that we have "no data" on the failures. I'll suggest that smoked electro-whizzies in builder's airplanes as the result of alternator failure is all the data we need!]

Jack's experience was not mitigated by the fact that his alternator was "not in a wild run-away" . . . the battery was the only thing standing between his failed alternator and all the other elctro-whizzies in his airplane. If the battery had been used up or even disconnected, the voltage would rise much faster and much higher.

That is the sum total of three hard failures I know about. Given my limited acces to all that goes on in the OBAM community, I was hypothesizing that for every event I knew of, there were probably many more that I didn't know of.

Oh, Bob you don't know that. It was mitigated by the fact the voltage regulator was still functioning; it was no big deal. Voltage was between 13-16 volts.

How do YOU know that?

I am sure in a few years this case will grow into a fairy-tale where the pilot was electrocuted and the plane bust into flames from exploding avionics. It is all sens facts. Take a deep breath. No harm no foul. Yes the battery helps any alternator. That is why my you don't disconnect it from the battery normally. If you do the alternator might be damaged.

Are you suggesting that the regulator was still functional but only "confused" to the extent that it was now CONTROLLING at 16 volts? That's a very interesting failure mode. A resistor suddenly changed value? A voltage reference decided to move a tad? I musts confess, the only hard failures I've investigated in regulators involved passive failures (shut down) or active-aggressive failures (ov runaway). The preponderance of my experience suggested to me that ov runaway was the failure mode he was seeing . . . especially in view of the bench tests I conducted that demonstrated a battery's ability to hold a runaway alternator down in the 16-18 volt range during an ov event.

In fact, your own design goals will DEPEND on a good battery to stand off the alternator while you react to the event.

You'll need ACTIVE NOTIFICATION of high voltage. Some suppliers of products to aviation embrace the notion that their products should stand off 20 volts for 1 second or more, this gives you a window of opportunity to react to the high voltage warning light and pull the breaker.

The only remaining dragon to slay is to make sure that the potential for fire at the spreading contacts propagating outside the plastic housing of the b-lead breaker is accounted for.

If you're looking for component reliability, you're correct. If you're looking for system reliability, my data is backed up by FMEA supported by 15 years of field history and a lot of experience in conducting such studies.

There you go. You have 15 years of crow bar data in experimental aircraft? Wow. We the basic ND design has been around for well over 15 years. I believe you, but how you get the data. You claim you conducted 15 years of field history study. How many are in service? What about the failures happening, which you have no idea of? One weak link in the home built world is there is no requirement to collect maintenance data. You will see maintenance bulletins the FAAs prints pertaining to all planes and sometimes a Kit plane will be in it, but most non A&P builders of experimental aircraft don't report or read this publication. There should be a FAR that requires or makes it easy for builders/repairman to report maintenance issues, including electrical. That way we would know whose alternator is failing.

An FAR? Please no. If you're referring to Service Difficulty Reports, those are solicited from only a small segment of certified aviation and even then, they're not mandatory.

Your field history data is no less anecdotal than my data. There never have been nor will there ever be a formal study by either B&C or ND (beyond warranty) so please don't dump that bucket of cold water on the discussion.

I'm suggesting that given thousands of B&C systems flying combined with both their stated policy of "no unhappy customers" for service beyond what others cut off with a warranty period, my anecdotal information about B&C's history is much better than your anecdotal about ND's history. I've worked for B&C and I have a reasonably close relationship with them now.

I have no fantasy illusions about the component reliability of ND nor do I have harbor such illusions about B&C. In fact, field history of either company has nothing to do with achieving DESIGN GOALS. The only reason I even mentioned my experience with B&C was because of an incoming cabbage inferring that the crowbar concept was ill-considered, evil and would never fly in the marketplace much less become certified on your airplane or anyone else's.

I'll suggest we eliminate field history of any/all companies from this discussion and concentrate on DESIGN GOALS.

I think you are super defensive and sensitive, Sir.

You read things into the words which are not there. They're intended only to illustrate the foundations for what is admittedly anecdotal data for feedback on system reliability and consumer satisfaction. Again, I'll suggest that including B&C or ND's admittedly un-scientific "field history data" have nothing to do the discussion at hand. I was only responding to your erroneous assertions of B*C's position in the market.

As I mentioned before, if I have an emotion to ascribe to my participation in this discussion, it's "enjoyment". It has been enlightening too. Otherwise I would not have taken the time.

I wish to point at nothing. I don't even know about all the past problems. I am nc trying to discredit anything or anyone. I think B&C is over priced not defective. However I think many comments regarding the danger of using an IR alternator ignore the high degree of reliability.

I have never said that the IR alternator was dangerous. I've only said that there are failure modes that cause an OV runaway that cannot be controlled from the out These are simple assertions of fact. You can ascribe whatever degree of comfort is offered by your perceptions of field history. When people look to me for idea it's best not to qualify any recommendation based on a particular brand if it can be avoided. Figure Z-24 didn't speak to alternator brands, only IR alternator

The ND is an unknown since we cant look into the IC chip. However that is moot sinc have isolate the weak link, the field driver transistor, not the IC chip. As I saic the ND engineers are NOT ignorant and these products are very mature. Regardless, y can always pull the B-lead CB manually (if you have one and you should.

I've not attempted to isolate anything. There are failure modes that will result in runaway. If you're comfortable with your choice of alternator such that this simple statement of fact can be ignored, I'm pleased for you. But I cannot embrac it as a teacher because I just don't know.

If you want to protect an individual piece of avionics, you can use a device like a (tm) or Mosorb that will break down at a set voltage like a zener diode. This will blow the fuse or CB for that item (like a crow bar). This may not be necessary sinc most modern electronics which have internal OV protection and can take 30 volts and 60 volts spike (except icom a-200). Also no one can put an exact max voltage on an condition. The last one was 16 volts. Yawn, no worries.

Really? Paul and I had some discussion about this some time ago in the article I cited above.

We finally resolved to talk about load-dump in the automotive parlance where it's assumed that the battery is not present to keep the bus voltage down.

Here I did a "worst case" analysis that challenged Paul's

assertions that Transorbs could be depended on to stand off the effects of load-dumps and ov conditions and (gasp), crowbar the breaker open. The energy numbers didn't add up as described in the article. A concept you've also embraced above. If it's okay to depend on a Transorb to open an array breakers in case of an OV event, what's wrong with opening THE field breaker for precisely the same reason?

I'll agree that as long as a good battery stays on line the overall risks to the rest of the system (ESPECIALLY when qualified to DO160 Power Input testing) is quite low. But Paul was intent upon stacking battery disconnect on the equation. Similarly, I was insistent on considering the overworked battery.

So it finally boiled down as to which breaker(s) you were going to overload and how long you were going to wait before the desired outcome was achieved. The use of Transorbs for mitigating ANYTHING over a hand-full of milliseconds is shaky. While advertised as useful in mitigating automotive load-dump situations . . . this must be done with care and the better solution is to trap the load-dump event off at the source and let Transorbs do what they do best, trap very short transients.

By endorsing the use of Transorbs downstream of a breaker, you've just validated the crowbar OV system design. The only difference is, you choose to overload lots of breakers by a little bit and wait perhaps seconds for them to operate, I overload one breaker by a lot and boot the puppy open in milliseconds. One only needs to study how much of the alternator's excess energy is dissipated in the two events.

Crow-baring a field breaker is at most a 200 watt-second event. Crow-baring bus breakers will be many times longer killowatt-second event and depends on balancing the loads across the array of breakers as described in the paper.

I have talked to Van many times. I've asked to do a weekend seminar for their staff like I did for Lancair. I'm going to do one in their neighborhood and HOPE some of their staff will attend. I may have to specifically invite them and/or offer free tuition.

That is real nice of you. Why call the man ignorant? Did he NOT get all excited abo
FUSES, central ground and crow bars? Really there is nothing really new under the s
Bob. Van has common sense and an eye on the BIG PICTURE, not just the minutia of or
possible electrical problem that is not that common any more. (In the old days ther
where lots of OV because the external VRs where crap.

Because he demonstrated his lack of knowledge in the discussions I had with him. He has a superior knowledge of airframes, engines and flight controls. It would be foolish to expect him to be equally versed in electrics.

You've stated that you have no personal knowledge of the internal workings of the regulator chip in an IR alternator, nor are you privy to schematics upon which one bases a failure

mode effects analysis.

Oh Geeee Bob, I suggest you have not processed the info. I told you at least 4 times I cannot get any detailed info on the IR chip inside a ND. I got some general sales claims about OV and Load Dump protection but nothing real technical.

Exactly! You have the same level of ignorance about the internal regulators as I do. You're comfortable brushing this off based on your demonstrably anecdotal field history; I cannot recommend them precisely because I don't have the necessary data either and I will not base a recommendation on field history that I did not personally put my hands on.

Again Load dump means 5-10 amps, not 30-60amps during a B-lead abortion from a crow

How do you get this? If you're just done a hard start and the battery is being re-charged, the alternator will be running at or close to full-bore. Turning the alternator switch OFF under this condition will generate a load dump much greater than 10 amps. This may in fact have been the conditions that prevailed during the reported failure I cited above.

Turning the alternator off during an OV condition is guaranteed load dump equal to or greater than the alternator's nameplate rating. A risky event indeed.

OK Bob how much as electrons changed since 1950? My guess 1950 and 2005 electrons are the same. I cant believe there is anything real bad about a 1950 Cessna with the added IR alternator. We are talking about DC circuits. Bob here is your distinguish wiring (MO) Modus Operandi:

-Central Ground (excellent idea I might add)

-B-lead fuse forward of firewall , connect to battery before buss**

-Automotive fuse block and ATQ blade fuses

-Spade connectors vs. ring

-Crow bar

**(Use of B-lead fuse vs. a panel CB sacrifices alternator control. Suggest the ov
Well if you use a CB for the B-lead in the panel, you have control.

. . . and perhaps a great way to set the breaker on fire.

Circa 1950s Cessna (and Beech / Raytheon) probably has crazy wily-nily grounding schemes using multi point airframe grounds too much.

Yup, they'd like to make it better but it costs us

about $2K just to change one page of engineering documentation not to mention costs of certification. That's never going to get fixed.

It also probably has a big fat CB on the panel for the B-lead, which is no big deal

Nope, production airplanes at RAC DO NOT bring the b-lead into the cockpit. The b-lead protection has been ANL current limiters on the firewall for many years.

Click here to get a view of the firewall on a Bonanza. See all those current limiters? They've REPLACED the b-lead breaker (amongst others) in the cockpit.

Note also the fist full of glass cartridge fuse holders just above and to the left of the ANL patch . . . also off the panel.

As far as materials I don't think Van uses 1950 wires and connectors. I am sure his kit uses new mil spec wires and modern crimped connection. HOW BAD COULD IT BE? I looked at Tony Bingelis Books and than yours, Bob. Wires are wires. DC circuits are DC circuits. We are talking about a simple DC power distribution system. You don't know Van. It is not ignorance; he just does not give a rats ass about the smallest electrical details that will affect .0001% of his builders. If it gets the job done than it is good enough.

Van's choices of materials are not and have never been a problem with me, why do you raise the question now? Why include a listing of my noteworthy contributions? How does anything offered by Tony bear on this discussion? I've often written that if folks are happy with the way their antique certified ship's electrical system performs, then it's perfectly okay to lift that system out and drop it into their new RV - which is exactly what the majority of OBAM aircraft builders are doing.

If that's a builder's design goal the Van kit (with admittedly suitable materials) is the way to go. The only later-day contribution offered in Van's plans for appliances is incorporation of a modern, internally regulated alternator . . . which the builder MUST control with a b-lead breaker (also part of the kit). We were never discussing Van's or anyone else's recommendations of installation materials.

None of this contributes to the discussion at hand . . .

>Except that we CAN design an electrical system that will
>NEVER be a link in the chain of events contributing to
>a catastrophe.

Can never say NEVER in an airplane Bob. That is the answer I expect from an electrical engineer. You can try and believe you have designed the perfect system, but there is nothing perfect. A little piece of foam destroyed the space shuttle. Apollo 13 went boom from a faulty heater.

Forgive me, 10-to-the-minus-6 probability or better is "never" in FAA parlance. Given that we don't have

10-to-the-minus-anything data, the word "never" was inappropriate. Further, I've never suggested that any system philosophy was "perfect" only "failure tolerant".

>Voltage regulators are not the issue. Alternators you >cannot control are the issue.

Oh Bob Bob Bob, you love to sensationalize, you CAN control an IR alternator: First Pull the B-lead CB or Second) . . .

Assuming the breaker's internal performance will break the arc and/or the breaker's enclosure will contain the fire.

Turn the master switch OFF. You have isolated the alternator. I understand what you are saying, but statistically you are myopic. The pilot is the key to safety not the engineer.

???? Gee, does this mean I can do anything in the way of system design and architecture as long as I put the right words into the POH under EMERGENCY PROECEDURES?

Even a crap electrical system is the most reliable thing on a small plane. Loss of an alternator should not be fatal. What is a pilot doing flying IMC of mountains at night.

I don't do it . . . but my boss says lots of our customers do it. I have dozens of hi-performance OBAM aircraft owners who do it too . . . and I hope with very simple paragraphs under EMERGENCY PROCEDURES that prevent any incident from propagating into an unmanageable event.

You are a typical design engineer that feels you can control everything.

You cite facts not in evidence. I take cues from my customers and supervisors to achieve their vision for how the products I design should perform. It's my duty as an engineer to either meet all goals as requested or give good reasons by FMEA (or limits to available technology) as to why they cannot be met. Even AFTER the goals are met, they may never see the light of production line due to costs, volume, weight or customer acceptance. This has nothing to do with your perceptions of my FEELINGS as an engineer, typical or otherwise. If this working philosophy departs from your perceptions of a "typical design engineer" then so be it. I readily confess a desire not to be "typical" in any regard. Thank you for the compliment.

I understand your engineer mentality. I don't care about a crow bar; I care about living. Don't over estimate the significance of this one item to miss the big picture. By adding this protection device you introduced another failure point. Does it justify adding it?

You betcha, as long as adding that component drives

probably of comfortable termination of flight UP and not DOWN. The design goal was to keep the worst the alternator can do from propagating out onto the system and without adding new pilot responsibilities. This is what my bosses and the FAA would require me to do. One excellent way to get re-assigned would be to suggest a system that requires a pilot to perceive, react and effect a generator shutdown for the OV condition no matter how probable that condition may be. The assumption for the OBAM aircraft community has always been that there will a simple, Plan-B to implement and allow comfortable termination of flight.

Don't scare people with sensationalized rhetoric. That is a cheap game plan for someone who likes to be thought of as a benevolent impartial teacher and engineer. No rocket science, just basic DC circuits 101. How can you not understand that? It is not as complicated as you like people to believe. EVERY ONE KNOWS BOB CAN'T RECOMMEND THE ND ALTERNATOR. OK. YOU WIN, I AM WRONG.

I've sensationalized nothing. I've tried to deduce a means by which the design goal of incorporating IR alternators into light aircraft can be accomplished under the SAME design goals we're familiar with and have been flying for years.

I avoided the subject for years in the first 7-8 revisions to the 'Connection. In deference to CUSTOMER demand, I attempted to craft a satisfactory incorporation of the IR alternator while staying within the design goals of past designs. Except for (1) a shortfall in contactor performance to survive and (2) vulnerabilities in the alternator's ability to stand-off it's own load-dump events, the experiment almost succeeded.

So, bloody but not bowed, I've retracted my recommendations. However, you've stepped forward with recommendations of your own which may be accomplished if one is willing to embrace your design goals.

You've accurately described your architecture and operating requirements and I would ENCOURAGE any builder reading this exchange to adopt your suggestions if they are consistent with their personal design goals.

This doesn't change my obligation to suggest that your philosophy as I understand it has forces the following considerations:

(1) a marked shift from past philosophies concerning alternator control and does not accommodate the need for pre-flight testing of auxiliary or standby alternators. This happens when the pilot is not offered absolute, any-time, any-conditions, risk-free CONTROL of the airplane's electrical sources.

(2) there are considerations to be explored and resolved - smoke from circuit breaker plastic is not from Marlboro Country.

(3) Further, the builder should provide the same quality

of warning for high voltage as for low voltage. I prefer to automatically sense and control an OV event.

(4) Then consider the new para . . . (oops) design goal that puts the pilot in the loop to provide timely reaction to the OV event.

(5) finally, this design philosophy is not friendly to the idea of keeping the most antagonistic wire in the airplane out of the cockpit - a design goal adopted by many type certificated aircraft.

Thank you for the gray-matter exercise. It's been fun except for your use of words that appear intended to demean or injure. I'll leave it for future readers of this exchange to decide for themselves as to which of us is most disposed to the use antagonistic, sensationalistic speech.

Bob . . .