Back to GV Series Up to Series Up to Media

Sigma

Customers are always right!
No?

It worked until it didn't!

And it worked for nearly 40 years

Starting to lose their grip on the market

Spanning the 3rd Revolution

The 3rd revolution is be From the Trenches *n*

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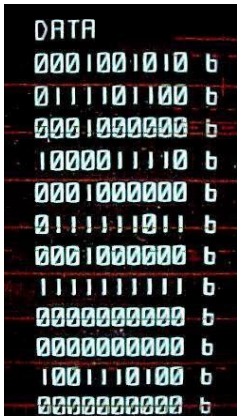

For a moment let's examine the gulf between the Industrial and the digital revolution, and how the Group handled their transformation because of it. The first revolution was mankind's harnessing of agriculture. The move from a primarily agricultural society to a society that embraced machinery and automation, which replaced many of handcrafted products and goods offered before, was the second revolution. The third is the digital revolution. This ushered in what has become known as the information age. The roots of this phase started back towards the later part of the 19th century but did not reach critical mass until the invention of the transistor, and then the integrated circuit. The Grass Valley Group came into being right as the transistor was making major inroads into electronic circuitry. Because of Dr. Hare and Bill Rorden's early mastery of the transistor, the Grass Valley Group never offered a product that used vacuum tubes. Another electronic juggernaut, that made the same early commitment to solid state electronics was Sony, which entered the United States shortly after the Group got started.

Vertical Integration

Even though the Group was now firmly under Tek management it continued its rise in the ranks of the high-end television production equipment industry. This rise manifested itself by the number of employees and real estate the company occupied. While today some companies can grow financially large with few added employees, back in the 60s and 70s that usually was not even a remote possibility. To grow a company like Grass Valley, they needed to put more people to work to produce more products as sales increased. Either by contracting some of the work out to others, or by hiring people to do the work "in house." Grass Valley evolved using the second approach. It was a highly Vertical Integrated company as it handled almost all its required stages of production. Early on it even handled all its own sales and marketing.

It made sense that the Group took this approach when it did, for a number of reasons. One reason was timing. When the company started in the electronic manufacturing business [illegible] components that made up that equipment were much simpler to create

rudimentary assembly line where circuit boards could be stuffed with parts and soldered, and installed in a case or enclosure, and finally some test equipment to make sure the assembled product was working correctly.

When the Group first started shipping products they did not even have to manufacture or etch circuit boards. As mentioned in earlier articles, they used boards that had rows of continuous traces that they would manually cut to organize the components into the required circuits. None of the electronic components back then had any complex mounting requirements. Frames and enclosures were constructed using sheet metal, steel ribbing, and tubing. This approach to enclosures and cases continued into the 90s at the company long after circuit boards and control panels had evolved to be quite complex.

Another reason why many smaller companies that grew up around the Grass Valley Group are still very vertically integrated is that they manufacture what is referred to as "low volume, high mix." Historically equipment aimed at broadcasters and other users of high-end television equipment was quite expensive. As such it had a limited market. Also, most of the gear these folks buy are not stand-alone pieces of gear, as a camera or microphone might be, but they are used in conjunction with other equipment that comprise a system.

That system is composed of a mix of gear that is installed to allowed users to perform a specific workflow. That is, a series of tasks performed both sequentially and in parallel to deliver video programming to the viewer. A station that does a lot of news will have an entirely different workflow than a movie channel. Sports channels will work differently and have people doing different tasks than a channel that does talk shows.

Thus, a piece of equipment in this industry usually must be able to be vastly configurable to meet these

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Often the model X video switcher needs to be produced for one customer that needs 20 video sources fed to it, while another needs 100. As we will see video and audio do not come in one flavor, and today they number more than Baskin-Robbins has flavors of ice cream.

Vertical Integration makes sense when supply chains are not stable, like right after WWII, and before just in time overnight shipping came into being. Transportation is much more robust today. When the Group started roads from all directions into the area were 30 miles of two-lane road, through hills and mountains. Even the main road from the town of Grass Valley out to the Bitney Springs site had a one lane bridge. Often large trucks headed to the site had to make a dozen mile detour and approach from the other direction.

So, for the first 30 years of its existence vertical integration made sense for the Group. The Grass Valley company today still does much of its own manufacturing, just not in the Grass Valley area anymore, as we will see in later articles.

Dan Castles, who was the Groups president in the mid-90s said that when he got involved with the company it looked like a postwar company, as it was heavily vertically integrated. The first time Dan drove up highway 49 in the mid-80s he could not believe a 1000 person company could be up in that part of the world. Dan was the VP of Tektronix's Video Division. At the time the Group had 1200 people working for it worldwide, 900 in Grass Valley.

Printed circuit board layout - before computers and CAD
More art than engineering
An eye for detail and a steady hand

Manufacturing

Being an outpost in the Sierra foothills, the Grass Valley Group evolved doing as much as possible for themselves. From printed circuit board fabrication (PCB), stuffing parts into those PCBs, machining frames and panels, to testing the final product, originally the Group did it all.

Early on, the Group took raw material and parts in, and through machining, etching, and assembly produced finished products for sale. As we have mentioned, at the volumes we are talking about it would not have been very economical to job any of that out in the early years of the company. At one point the Group had ab

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hundreds of cutouts, mostly done by hand, for all the switches and other controls that would end up in them.

Machine shop employees work with heavy equipment daily. Pictured here with the "Strippit" punch press are some of the day shift machinists, counter clockwise: Roland Fassett, John Murray, Dennis Moebus, Fred Stowe, Don Sager, Diane Durkin, Phillip Danenberg, Randy White, Bob Butterfield, Diane Fadel, Bob Liebgott, Russ Bentz, Dale Restad and David Kerr.

Computer programming of our automatic drilling for PC boards and of large equipment in the machine shop is done on swing shift. Members of the swing shift crew are pictured here, from l-r, back row: Jeff Bernard and Paul Silva. Third row: Jerry LaFerriere, Dwayne Elmore, and Loren Jacobs. Second row: Dave Arnold, Jim VanDusen, Ken Still, Frank Kerner, Bill Johnson and Betty Price. Hayden Bridwell and Steve Wheeler are pictured in front.

GVG Machine Shop employees, day and night shifts

Machining hardware into finished produ
Raw metal stock generally arrived as she

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or a milling machine, or both. Drilling operations were common in many parts. Both the milling and lathe processes are similar, but the simple explanation is that with a lathe the part being shaped is rotated while the cutting tool is stationary. With a milling machine the piece being worked on is stationary while the cutting tool rotates. Often individual parts were then manually de-burred, welded to other parts to make a larger assembly, sanded, and then painted or etched/anodized.

Anodizing is an electrochemical process that converts a metal surface into a durable, corrosion-resistant, anodic oxide finish. Aluminum is ideally suited to anodizing, although other nonferrous metals, such as magnesium and titanium, also can be anodized.

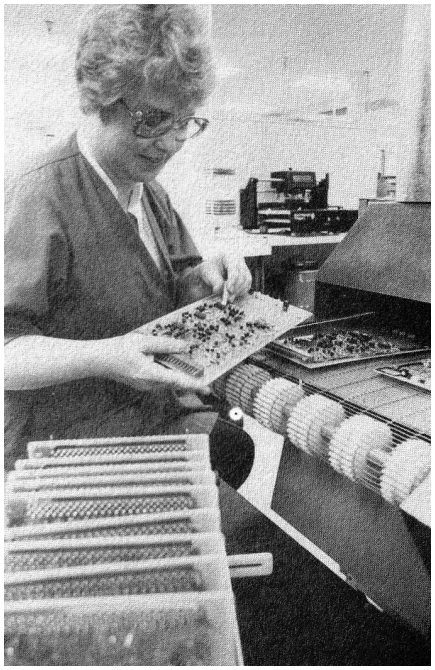
Even back then not everything was done in house. Any parts that needed to be painted were sent to outside vendors. Raw sheet metal, which generally formed the outer enclosure needed to undergo punch, bending, additional shearing, drill and tap operations. In addition, these parts would often undergo etch/anodizing or nickel plate processes. Nickel plating provided a combination of corrosion and wear resistance. It can add brightness, and luster. It also adds adhesion properties for subsequent coating layers, which is why nickel is often used as an 'under coat' for other coatings, such as chromium.

So, the Group, by the 80s was doing almost all of its own machining, and thus most non-off-the-shelf parts where created at the Bitney Springs site northwest of town. When you make your own parts you not only have to worry about keeping the assembly line stocked but also need to create replacement parts for product already out in the field. As such the Group divided the parts they used into three categories with the highest grade, parts that had some cosmetic appeal, such as operator panels, were individually packaged in foam. The next level parts were individually wrapped, and the lowest level might be packaged in paper and plastic or simply piled together in a parts bin.

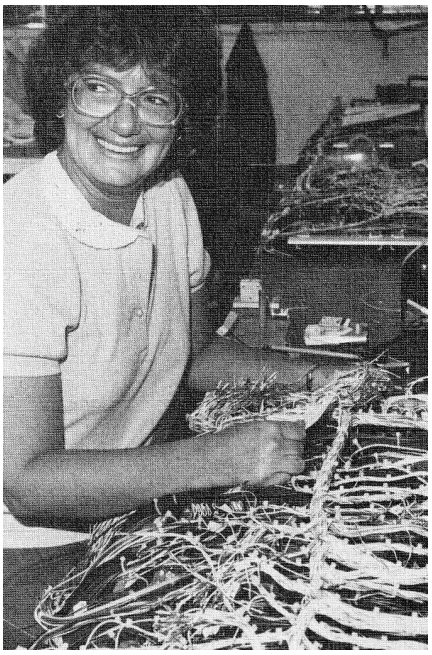
Flow line assembly, where parts are "stuffed" into circuit boards, wave soldered, and then those boards are cleaned of all the solder resin residue.

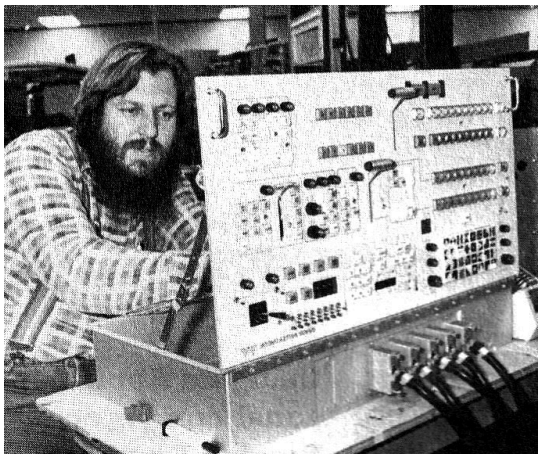
The Group in the early 80s went from assembly lines where a single installer might install all the components on a particular board, or completely assemble the enclosure for a product, to what they called flow Lines. Here each assembler only installs a couple dozen components, and it then moves on to the next assembler. The Group hired an assembly engineer, Larry Hoy, t

components that were now just dropped into holes in the circuit board by assemblers. This led to higher productivity, but for the person doing the assembly the task became repetitive and there was a loss of pride as a complete assembled board was not a particular assembler's anymore.



The PCB operations grew to a point that in early 1982 the mother company, Tektronix, gave the Group an order for 3,200 PCBs for a new product line being launched in Oregon.





Finally you need to be able to test and configure the final product

As we will see later, as the company continued to change hands, and merged with operations from other companies, some that made competing products, the Grass Valley and Nevada City engineering and manufacturing fortress began to lose out to others spread around the globe. That was not always the case. Shortly after the Group was acquired the third ti

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brought to Grass Valley. But in later years the bulk of the work migrated away from the area. By 2015, and with the fifth acquisition, this time Belden Cable, the last of the manufacturing was moved to Montreal. We will see later how this saga played out as owner after owner applied successive management philosophies.

But just as Thomson had their Salt Lake City router operations moved to Grass Valley, they also tried to have as much as possible made in Vietnam. The problem is this is only economical if you make many of something, not a few, like Grass Valley was doing. If you are building offshore a few Engineering Change Orders (ECO) that crop up can throw any savings right out the window.

The thought here is that many manufactured goods come out of China today, and since Vietnam is a neighbor, although neither are friendly to each other today, the same cost savings might be had. There are a couple reasons this did not work. One we already mentioned. But the other difference is that the Chinese have the infrastructure to iterate many times until they get a manufacturing sample and then copy it millions of times. Hard design is a small part of that process. Again, you cannot afford this in low volume/high mix manufacturing.

While process is important in any set of steps to take raw parts and materials and turn it into a finished shippable product, the task gets much more intricate as more of the finished product is siloed together. Birney Dayton, who had several hats at the Group, director of engineering was one of them, and later spearheaded the Groups only real spin off, NVISION, was an early apostle of process, and the aspect of who was responsible for it every step along the way.

Complicated electronic equipment, which is what most of the Group's products were, created many opportunities to get things wrong in their design and construction. Not only did the

panels) and the software that even back then drove much of the hardware, but then manufacturing has to be able to replicate the design and see that it is built so that one example of a product is indicative of all the others like it.

At each juncture, the chance for missteps is many. It starts right after the design phase. Even if the engineer nails the circuitry needed to accomplish a given function, how is that design, usually in the form of a schematic, conveyed to the people who need to document the design. While considered quaint today, schematics and other parts diagrams used to be considered a required ancillary part of any product package. Thirty years ago, schematics were considered essential as most professional television facilities expected to be able to repair the equipment they bought.

At one time technicians at a facility were expected to troubleshoot problems down to a particular component on a board and replace it. Over time PCBs became so intricate that they could not be repaired in the field as the owners of that equipment could not justify investing in the expensive equipment necessary to accomplish that. So troubleshooting was just to determine which PCB was defective. Today many product's parts and subsystems are so intertwined and constructed as to not allow anyone but the manufacturer or authorized repair agent to successfully deconstruct, repair, and re-assemble a broken product.

So even though schematics are useless now to the end user, they are still vital to the manufacturer. Just as the product has become too perplexing for outsiders to cope with, it has become increasingly complicated for those who build them. So back to the schematic. The blueprint of the designer's solution. It is a collection of data points that must be managed and tracked. The manufacturing engineer must control each piece of data, that there is one point of entry, one master record. They must control who can change that record or piece of data. Inevitably new designs will have lots of changes as problems crop up in produced products, and they are corrected. In the 80s, before software like AutoCAD became ubiquitous, schematics were usually drawn by drafters. The engineer would hand draw their circuits, pass them off to the drafter, who would return the "form

Today, with all the advance design software available engineering will create the schematic, it won't be scratched on a piece of paper and handed off to a drafter. Today the schematic capture tool has the parts data in it and creates a Bill of Material (BOM). No human hand touches the BOM. It has hooks to add mechanical pieces to the board. Now PCB layout software adds location and orientation data. If the layout software catches potential errors: such as traces that are too long, or the need for more capacitors, engineering must correct that, not someone else. Today only the originating engineer should touch the schematic.

The manufacturing department programs the pick and place machines, which includes the order of assembly. Big parts might be found to be in the way of small parts. Again, new data, that must become part of the same master record. An important part of the auditing in this manufacturing system is who owns each data entry in the record. Mistakes happen when many can change a record and thus no one owns that piece of data. Errors can quickly creep in.

While greatly automated today as you can see, imagine in the 80s when the process lived on paper schematics and checklists, and not in database records as they do today. What automation was available then lived as islands of data and not networked together so one database can control the whole process.

Today the biggest hurdle is that the folks overseeing the corporate IT structure often insist on being the overlords for the process and manufacturing engineers that are held responsible for the final result.

A big goal for a company is to have as many early examples as possible of a product be fixable enough to be salable. In the 80s that might mean only 50% of first run boards. Today it is expected to be near 100%.

In addition, as we have mentioned, the Group, as with many other vendors of high-end video equipment, both in the area and worldwide, must be able to cope with low volume, high mix products. When you are doing low volume, and high mix you need your own manufacturing, otherwise it is too expensive. This means those companies need an economic manufacturing quantity of one. They need to make one of something and make money at the same

for a different product, besides maybe changing out a parts wheel, is as little a task as possible.

As we will see through the 80s and into the 90s the vertical integration process worked fairly well for the Group. But not always.

Hence: You need a facility that was known as Bitney Springs!

Bitney Springs

Originally the main path from Grass Valley to the site required crossing a one lane bridge!

Virtual Campus Tour

While the Bitney Springs site would not make much sense today, it made sense when the Group did most things itself.

As discussed elsewhere Hare bought 80 acres of property he had discovered back in the early 60s. It had a good view of the Sacramento Valley, and it was at an altitude that allowed it to be above the winter tule fog layer that sometimes hung over the valley. A previous owner apparently had planned some development on the land and had leveled an area that was perfect for a building pad.

As also mentioned earlier, Hare got a deal on the property because he put out word that the property he had already obtained was to be used as a chicken ranch. Some wondered if Hare had got the idea to claim that because after Hare and Litton had their falling out, Hare quickly set up shop in what was an abandoned chicken processing plant.

Originally the area only had single-phase power, and after fighting with the power company the required conductor was added so that the site had three-phase power. The site had natu

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company built a water tank on high ground to store the water and provide adequate water pressure and created a couple ponds.

The Bitney Springs site always faced a fire danger, and Hare had stated that if there was ever a fire that came through and took out the trees that he would have to move as he would not be able to stand the desolation. What did not help was that the site had Manzanita which burns very hot and is difficult to extinguish. They kept a gasoline powered pump with attached water hose near the lake and the main building. The company's maintenance crew regularly cleared fire lanes to minimize the spread of fire. They created a second pond to increase the amount of water available to fight a fire.

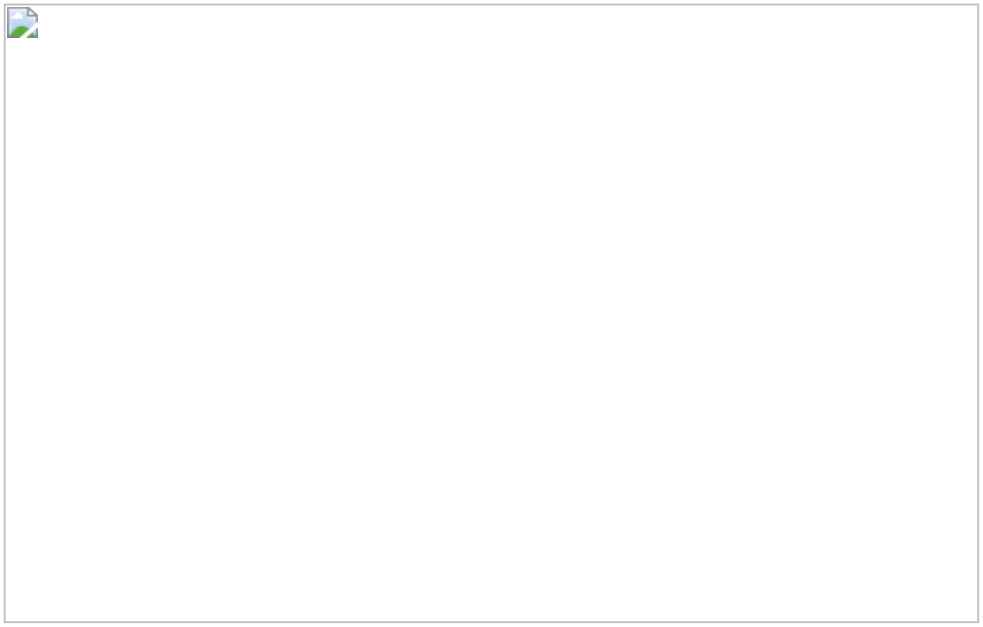
So besides the original building one, a A-frame house for the Hare's on Kentucky ridge overlooking the site and Deer Creek to the south, and a guest house, were the original structures on the property. Eventually the guest house was consumed by fire.

Building one was everything at first; administrative, modular test and development, Dr. Hare's office, and even early routers.

Growth was thus that three more buildings were added in 1969. The site had grown to 120 acres set amongst the trees and it looked more like a college campus than an industrial park. A lot of this growth was from the sale of video switchers, which then comprised over half of the company's sales.

As the 60s wore on, more television stations were specifying Grass Valley gear sprinkled in with RCA, GE, and other large vendors when equipping a station. The volume of products being sold and produced had increased to a point where the Group needed to consider building a second building. Since Hare did not want to take trees out of the current property, he put an option on an adjacent property that was an open field, once used for cattle grazing. By the end of the year the Group owned that property and promptly set out to create a building identical to the first, mainly to save time as orders were increasing and lead times were getting longer. Building two became everything switchers. Eventually building two was the model shop for prototypes and technical arts (manual publication).

Building three was manufacturing, the machine shop, PCB fab, & assembly. The building had two wings; one was PCB fab, and they had to re-pour the concrete floor in that wing of the building after PCB operations moved out. The other wing of the building was where the machine shop was. Later when the machine shop moved to building nine the wing became manufacturing. CAD (design) was also in that wing, which at the time was composed of Intergraph graphics terminals and a VAX central computer. This was long before the advent of the PC and Sun and Silicon Graphic workstations. Later Intergraph played a larger role in the Grass Valley story.



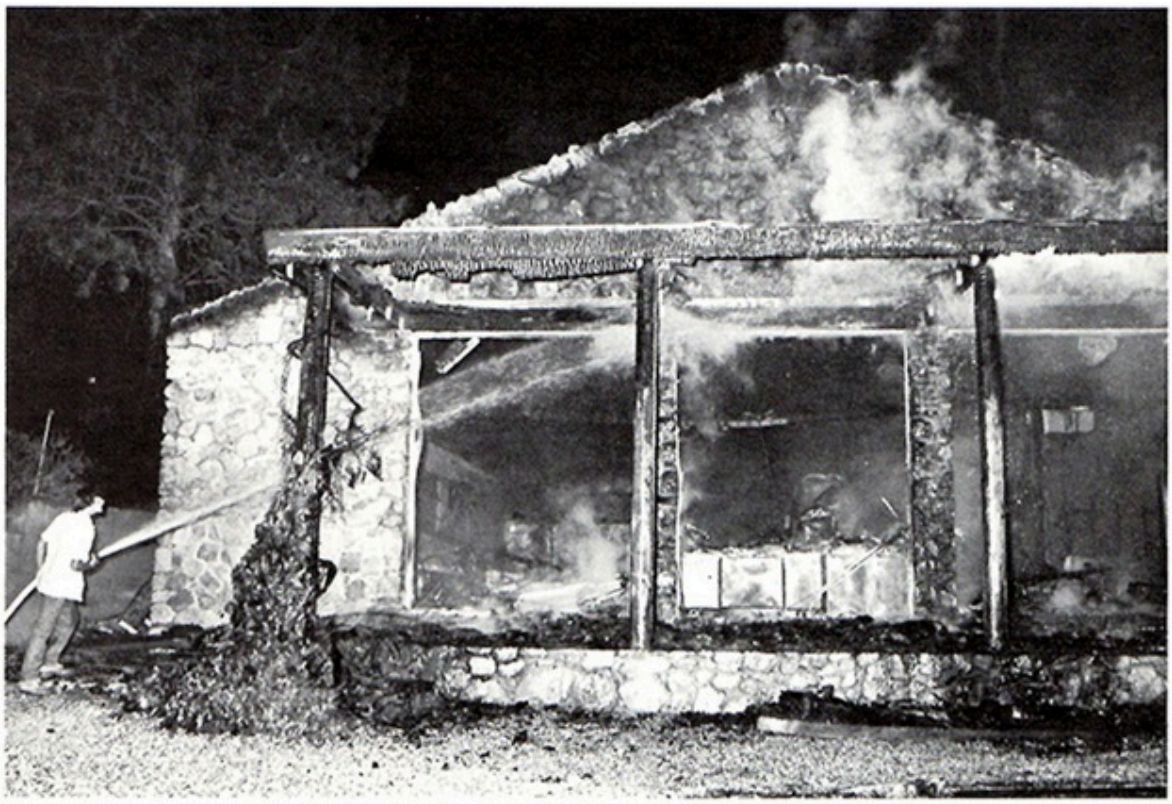
Building 4 1977

In 1976 building four was built. Production switchers and routers moved to that building. It was the stateliest building on the campus and was the center of gravity for the campus for a long time. It made a great initial statement as you drove up through the main entrance. Sadly, today it is closed and not used by the current site occupants due to internal mold issues.

Trade magazine account

Building five was built in a hurry after building one burnt down on August 1st, 1977. Buildings 5, 6, and 7 were all metal buildings.

What was in building one was moved initially into Dr. Hare's house, then into building 7 when it was completed. Building 7 was thrown together and used shredded paper infuse



GRASS VALLEY GROUP'S Building No. 1, which housed administrative offices and design engineering, was totally destroyed during an early morning fire last month. Two nearby fire departments and the California Department of Forestry fought the blaze. More photos and story inside. (Photo by John Hart of the Grass Valley Union.)

building to insulate it. Heat in the building were open radiators not vented to the outside. Company engineer Jim Michener walked in, looked up and said, "you know it's going to rain in here." The gas heaters produced water vapor that condensed in the insulation. He was right, it did rain in the building on occasion. Building 7 and 8 both had heating issues over the years. Early video routers were assembled in building 7. Eventually building 8 housed the executive offices.

Building Nine under construction

Building 9 was next after 8, actually 8 and 9 were practically built concurrently. Building 9 was started in 1979. But it was not finished until the beginning of 81 due to an electrician's strike. The building was the sites largest at 76,500 sq ft. PCB fab moved to building 9 first. Switchers a

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Eventually the building also hosted systems assembly and test, manufac

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assembly and test, the machine shop, production control, and admin. The building at one time hosted more than 400. Up until this time switcher control panels were manually cut out with a template and finished by hand. With the move into 9 CNC was introduced to speed up switcher panel construction. The building was the first with its own backup power and had a fairly elaborate HVAC system controlled by pneumatic solenoids.

Sadly, as operations started winding down at the site this building was one of the first to empty out.

The machine shop held out until the 90s when it was sold off. The company that bought the machine shop ended up buying the entire Bitney Springs site. Chuck Conners was running it. Metals at some point have just become a tough commodity to be in.

The last

Bitney Springs building: Nine
The building also hosted a number of company operations: Admin, PCB Fab, Machine shop, among others
Also, the view from the cafeteria in the building

Beginning of the end

In 1988 there were 1000 people on the Bitney Springs site. There was only one way in from Grass Valley. At the time the Group was producing $30 million of income, on a fire prone ridge.

On the ominous date of Sept. 11, 1988, the idyllic site was no longer that idyllic. A little after 9 a.m. what became l

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that was called home by a vet that was down on his luck. It started north of the South Yuba River and was quickly driven to the southwest by gusty winds. By the time it was contained on Sept. 13, it had burned 33,700 acres, 52 square miles, and had destroyed 312 structures, 148 homes (about 15 of those where Group employee homes), 89 vehicles and 17 boats. Approximately 3,200 firefighters, 285 Engines, 65 Dozers, 76 Hand Crews, 12 Air Tankers, and 8 Helicopters worked for more than a month to completely extinguish the fire.

Photo on the right is what's left of one of the GVG out buildings on the site

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COMMUNICATIONS GROUP VP Dan Wright surveys fire damage at Grass Valley. Photo is by Dave Friedley, who was on the scene early this week. More on page 3 today, and on Tek TV Monday.

At the Bitney Springs site it blackened 150 acres, or about one-half the site, and did $500,000 in damage, which happened to equal the company's deductible. It leveled two small buildings. While it threatened many of the site's buildings, they survived with a pink coating of fire retardant from air drops. The suppression costs were estimated at $7.5 million, and the total losses were estimated at $22.7 million in +30-year-old dollars. At the time, the 49er Fire was the 3rd most destructive fire in the state of California. Today It is not even in the top 20.

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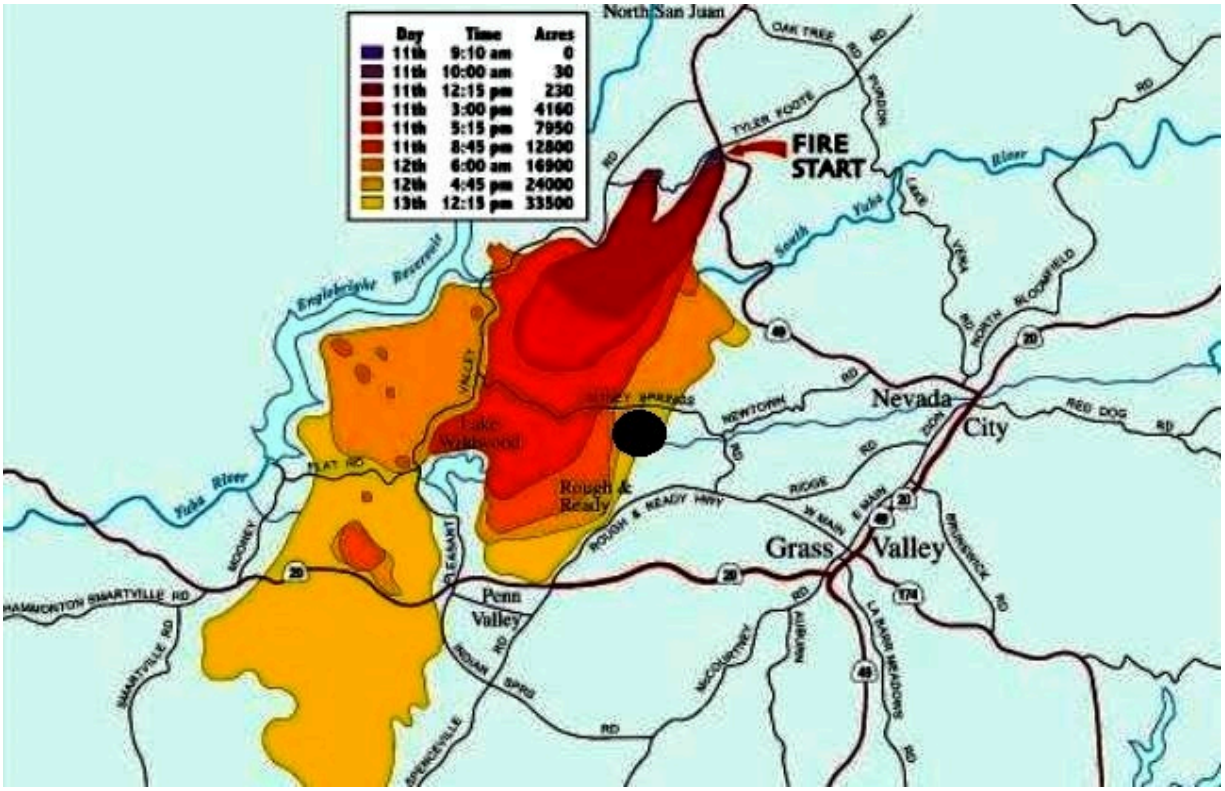

The 49er Fire map. Black Dot in center is the Bitney Springs site

The site also became expensive to meet the mounting environmental pressures and restrictions. The need to geographically diversify became apparent.

Besides the fire hazard that existed, the site was situated on land that was considered rural. It was the only industry of any size for many miles in any direction. Nevada County, which is infamous for red tape and fees to make any improvements on properties, was particularly attuned to policing what the Group was doing with the site. Many claim to this day that the county counts on fees and fines.

When the Group decided to rebuild building one here is a partial list of the hurdles they had to clear:

- Describe the property as it is now
- Describe the surrounding properties
- Describe any change in terrain
- Any geologic hazards
- Any change in the building footprint on terrain
- Effect on water tables
- Change in air movement, dust, pollutants

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- Change in area noise or vibrations
- Changes to flowing or standing water or marshes
- Changes in ground absorption
- Any change to animal habitat
- Trees affected
- Effect on the nearby community; population, transportation
- Effect on public services
- Effect on energy usage
- Effect on aesthetics and scenic views
- Effect on historical and archaeological sites
- Affect the employment and tax base of the county

Remember, this was not a new building, just a replacement for an existing one. At one time the company considered the possibility of employing 2000 on the site. By the early 80s that thought was fading fast. Even before the fire the fact that most employees were still crossing a one lane bridge (replaced in 81) and the site was miles away from major highways, started to weigh on the Groups management. Britney Springs site was becoming environmentally difficult to justify.

The fact that the building 9 generator had a couple fuel leaks did not help stem the County's scrutiny of the site.

While the setting was idyllic, looking more like a college campus than the site of the largest manufacturer in the county, it was expensive to maintain. Not only building wise, but the constant upkeep on the 300 plus acres the site came to occupy. The Group also had to maintain their own water supply. The maintenance crew spent a fair amount of time clearing brushes to minimize the fire danger.

Most employees liked the campus nested throughout the trees on the side of a gently sloping hillside. Employees would get around the campus via company bicycles. They would walk out of a building and hop on an available bike and pedal to their destination. Kids were hired whose job was to keep the bikes evenly distributed around the campus. As the company's growth slowed and demands to stay profitable rose, these types of perks were becoming hard to justify.

At the time, the area was a desirable place to live, and the Groups turnover rate was less than 15%/year. Up to this point many thought the company's employment growth rate would continue at 15%.

So, a change in management philosophy started to set in. Much of [illegible] From the Trenches [illegible]. In a

Slow to Digital

Outside forces were at work effecting the company's future. Digital video reached critical mass in the 90s, but it had been around for 20 years. The BBC did some of the earliest research into digital video in the mid-70s. But digital video had been making inroads into products at that time. The first area was digital control systems for products. Those started to show up back in the 60s, and by the end of the 70s analog controls were giving way to digital Boolean logic, and the use of ICs.

Another major development that pushed digital control forward was the development of the first microprocessor by Intel in 1971. By the end of the 70s there were several well-known, microprocessors from a number of vendors. One that really took off was known as the 6502, which found its way into early Atari, and Apple products in 1977. While the first microprocessor, the 4004, was four bits, the 6502 (introduced in 1975) and a slew of others soon touted 8-bits. By the end of the 70s Motorola had a 16-bit microprocessor.

About this time microprocessors started to find their way as the central control systems in television products. RCA produced the first computerized camera setup in 1979, the TK-47. It used an 8-bit RCA Cosmac 1802 microprocessor. Even this early, and many claimed, not very capable microprocessor, allowed the camera to do things none had done before. Using a computer allowed the camera to be setup in a minute, but allowed for much finer adjustments, and a lot more of them, then was possible before. While there were a couple adjustments that humans could do better than the automatics, it would get those adjustments close.

RCA TK-47

But when it came to registration, required of image tube cameras, but not in the coming CCDs, the automatic system was hands down better than any human. The author once watched a video operator attempt to manually setup a TK-47 at a Paul Anka concert in the 80s for ABC, as he said he did not need to rely on any computer to do his job. He worked hours to setup the four TK-47s in use. As [illegible] producer was yelling at the engineer in charge about why all the

was allowed to touch the camera controls, he could fix it in minutes. Being a union situation, a standoff occurred. As the show got closer the union steward finally realized that the show was in actual jeopardy if the situation remained unchanged. In addition, the engineer reasoned that while he could not operate the camera controls, it was his job to fix broken cameras. Finally, he was allowed. It took 6 button pushes and about two minutes. The cameras were fixed!

In 1982 Philips, who's camera line eventually became part of the Group, produced their first microprocessor controlled camera - LDK-5.

Other digital building blocks were starting to emerge around 1980. A big one was the Ethernet, and the IP protocol, which was being developed by a consortium that included DEC, Xerox, and Intel. Actually, Xerox had been using a proprietary version in some of their machines since 1974. At the time it ran on coax and was used to eliminate bundles of control cables between large copier subsystems, with a single cable. Eventually the interconnect cables between switcher control panels and the central electronics frames were replaced by the modern iteration of Ethernet, "cat 5" cables.

Most facilities evolved into digital one island at a time. With equipment that was digital internally to begin with. Eventually keeping it digital as video traveled from one box to the next. In time the islands became a "continent." In a way the same thing happened to the Group. In 1984 they bought their first subsidiary, Dubner Computer Systems. Dubner added character generators, and video p

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television to the Grass Valley Group product line. Dubner Computer

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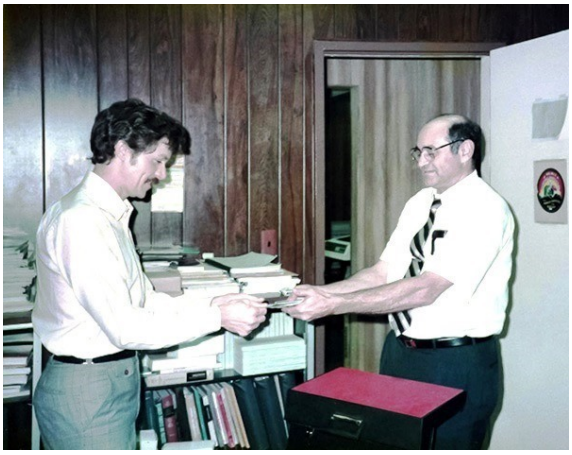
systems had multiple products from Credit Union software to lottery systems, along with hardware and software products for the television industry.



The founder, Harvey Dubner (right) was an engineer and mathematician who was noted for his contributions to finding large prime numbers.

He worked closely with a Canadian company, Colorization, Inc to develop software for his animation systems that would allow it to colorize black and white movies and programs. In 1986 Dubner was presented with its second Emmy for its work advancing the process. This was one of the first digital islands within the company. But we will see shortly that it was not the only one. The Dubner brand was eliminated in 1991.

The first digital boxes

Because of the fragile nature of the color signal in the old analog video systems, VTRs presented a heightened problem because of the mechanical nature of VTRs. While there was a trick that fixed the problemin consumer and low-end VTRs, it lowered the video quality, by producing what appeared to be "fuzzy" color. Actually, the heterodyne process, as it was known, made the color stable, but not the black & white or monochrome part of the signal. Since the TV receiver locked to the monochrome sync signal, it gives the appearance that it is the chroma that is fuzzy. But the heterodyne process was not allowed by the FCC to be transmitted by broadcast stations.

VTRs were an early beach head for digital video technology. To begin with Sony as early as 1977 began research into recording video on video tape as digital information. A lot of the future standards adopted for digital video were worked out during digital VTR research. An important one was what would be the sa

video into digital data. It was a tricky proposition, as the three

predominant analog standards at the time were NTSC, PAL, and SECAM, all with different color handling schemes. Eventually the common denominator sampling rate was determined to be 13.5MHz. The Consultative Committee for International Radio (CCIR), now the International Telecommunication Union produced Recommendation 601. Standard definition digital video went by several monikers, one was simply 601. The video recording format that used 601 became known as D1.

Why did VTR's have problems replaying color? VTRs recorded and recovered video information using a mechanically spinning head. As such, these devices were continuously running a little faster or slower than desired. This velocity error, as it was called, would play havoc with video timing, especially for the color subcarrier embedded in the video. This was caused by the fact that the scanner and capstan can never exactly duplicate the exact conditions found when recording or match the playback video to "house" video, which is used as the external video reference. To even out the playback, the video was converted to digital, marched into memory at the varying rate it was arriving in from the VTR, and marched back out at a steady rate that matched the required timing of the facility housing the VTR. This device was known as a Time Base Corrector or TBC. Before this, elaborate banks of electronics with lots of variable capacitance were used to produce adjustable delay lines. These pre-TBC subsystems were large and very finicky and only had a small correction window.

In 1975 a company called Consolidated Video Systems offered the first digital TBC. Technology had gotten to the point where memory was cheap enough, the components to convert video from analog to digital, and back again had gotten fast enough to handle analog video.

Description of TBC operation **here**.

A signal coming in from an outside source, satellite, microwave, the network, etc. while very close in frequency, if not exactly the same as yours, and they never were, then you could not use it in any effect. Even if the signal was at the exact same frequency, it would still be out of time with the local signal, as much as 524 lines.

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So a news microwave truck out in the field to do a live report, even if it could lock to the stations signal, it still would be out of time due to the propagation delay from the truck back to the station. The fix up until then was a bad one, lock the whole station, called genlocking, that is lock your sync generator reference to the signal coming in. Worked, but all the stations sources would hiccup every time the station went into genlock, and again when coming out. Any VTR that was in record would come unlocked and depending on the generation of VTR could take four or five seconds to relock. A big disturbance in the video. Thus, there was a market to fix this, and what is called the "frame sync" was born. That is, it took a whole video frame and locked it to the station's reference.

Soon it occurred to engineers that you could start to manipulate the entire digitized picture. In 1979 Vital Industries filed for a patent to do just that.

When digital effects first burst onto the scene with Vital Industries' Squeezoom Digital Video Effects, or DVE, around 1980, production changed forever. While the Group was still struggling with the 300, which would also greatly change production, they were squarely still in the analog realm, while others were launching into the digital realm.

Until then, it was not possible to manipulate the size of a frame, let alone perform dynamic effects on it. The Squeezezoom did just that, it could squeeze a whole frame of video into a smaller size and position it anywhere on the screen. That video could then be keyed over another video source. It could also zoom into video and enlarge a portion of the video frame. This was not used much because analog video rapidly looked bad as you enlarged it.

Yes, this all seems rudimentary now as video is easily manipulated on any desktop or laptop with $49 software. But back then 16-bit microprocessors were the norm, with 32-bit ones just arriving on the scene. The high-end ones employed under 70,000 transistors and ran at clock speeds of 10 MHz. Today, run-of-the-mill microprocessors bring hundreds of millions of transistors to bare and run at well over 1 GHz. Today microprocessors can handle video, magnitudes of order in quality above what was available then, and in real time. Throw in desktops with dedicated graphic processors to assist, an

Long time television engineers at the time were dumbfounded when they first encountered the DVE. Many engineers that were involved in installing these devices took delight in revealing what the devices could do to unsuspecting co-workers. Such as flopping the picture fed to a monitor, either vertically or horizontally. When the co-worker would exclaim in surprise what they had seen, the picture would then be flipped back before they could bring it to someone's attention.

Two channels of DVE. Today trivial, then it took hundreds of thousands of dollars to pull off

Previously, the content of a picture could only be composed of layered elements, principally keys and backgrounds. Digital technology, namely the creative use of computer memory, enabled the active picture to be resized and repositioned. Vital was not alone for long.

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In 1977 they came out with the Electronic Still Store or ESS. At that time if a broadcaster wanted to show a still photo, either they needed a slide projector as part of a film chain or they had a video camera to shoot a card on an easel. ESS combined the frame sync with computer high density storage to produce an electronic slide projector. Seems trivial today. It was not then. It also could record and playback sequences of video frames forwards and backwards at varying speeds. Again today, so what? Then, WOW!

Ampex, the video tape folks, while pushing VTR technology along, had also designed and built their own TBCs, as Sony was doing, to support their VTRs. Thus, they were cultivating digital video engineering and design.

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Ampex Digital Optics or ADO control panel

A year later Ampex introduced the first video paint system with a tablet and pen that allowed graphic artists to paint on an electronic canvas. Then a year after the Squeeze zoom debuts Ampex launches the Ampex Digital Optics or ADO, a DVE, that while a year later than the Squeeze zoom, was a full generation more advanced. It was the start of a DVE progeny, that would greatly affect the Group when they got serious about building their own DVE.

Soon Ampex had advanced from not only doing 2D moves and effects, but full 3-D, including page turns and mapping onto solid objects. At a NAB in the mid-80s Ampex demonstrated the effect of taking a flat Coke can graphic and rolling it up into a can shape. Ampex started offering an ADO that could manipulate and combine multiple sources at once.

When Vital and Ampex were launching their DVEs respectively, the Group decided to OEM a DVE that NEC had launched. The only electronics the Group added were the control panel and its interface. While it had the Groups touch and feel, the bulk of the sales revenue went to NEC and not the Group.

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When the Group finally got serious in 1984 about creating their own DVE, what eventually became known as the Kaleidoscope, shortened usually to just Kscope, the design team was given carte blanch to develop the best box they could. An immediate problem that cropped up was that the control group was at Bitney Springs while the video processing group was at the airport. The company had not quite figured out whose product it would be, PSD or BSD. Another problem was that Ampex had already boxed the Kscope design in with patents. To get around some of that the designers ended up having to throw a lot of additional hardware at the problem.

Kscope control panel

While the Group had experience with digital circuits to control things this was its first digital video project. While the company did bring new grads in that had exposure to treating video as digital numbers, it also brought in several engineers from the BBC. The British were generally leading the way, followed by Sony, in digital video technology. None-the-less, there was a steep learning curve. Video processing is quite different in the digital realm. Whereas analog video filters consisted of inductors, and capacitors, and maybe some active components, filtering in the digital domain was done in banks of shift registers with varying amounts of recursive feedback. Digital Si... known.

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The other thing that made this more doable as the group's first digital video project was that it simply took in analog composite video, sampled it at about 13 MHz/sec, and then performed whatever magic was required. But simply doing this did not alleviate the inherent problems of mixing the black and white information with the color information, which composite video was. Even at this time there was a better analog way of handling the color and black and white information. It was known as component video. The color and black & white information were kept separate and therefore did not interact with each other. The BBC and Sony were already working on systems that did the same digitally. The group was slower than most to digital, and as we will see slow to embrace component digital over composite digital.

All the hardware thrown at the goal made each channel of the Kscope DVE about 20 rack units high (about a yard), and each channel consumed 1600 watts of power. The cables from the power supply to the backplane motherboard for each channel were double aught battery cables. The Kscope was forced to use super-fast TTL and some ECL logic. To keep the size of the boards semi-reasonable, and to minimize propagation and timing issues the boards were exceedingly dense with components. Birney Dayton pointed the designers to Intergraph, who had a point-to-point wiring system from Kollmorgen (KM). Multi-layer boards were in their infancy at that point. The KM Machine would make as many layers as needed. It would stitch wires across the board; the wires were insulated. It walked across boards, daisy chaining connections and Electro bonding each connection. It hooked up a wire and welded it to the pad at the other end. The whole process was much like vector plotting. Intergraph ended up manufacturing the Kscope's boards.

A novel idea the group came up with was to be able to have multiple control stations, with each able to take control and use one or more channels. The system control was designed to control up to eight channels. Each channel had the equivalent processing of 16 of the most powerful processors of the day. With all that the Kscope could never quite duplicate the ADO's Coke can effect.

Another issue was the frame itself. It was designed using off the shelf aluminum studs, ribs, and tubing. Assem

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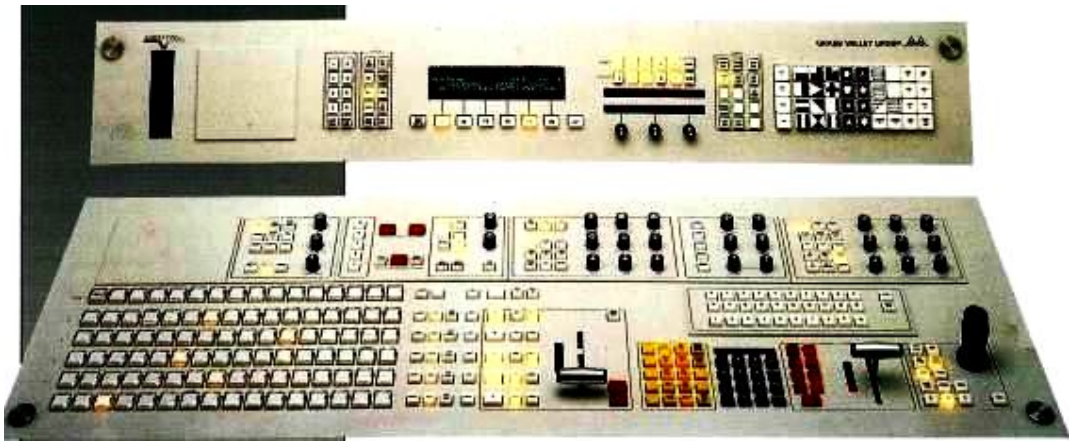
cooling fans, there were 18 of them prone to failure, that the fans were the first items in the frame to be installed. This is because to replace fans the technician had to completely disassemble the frame into over 100 pieces of miscellaneous hardware. It could be disconcerting to see a $150,000 Kscope channel reduced to a stack of boards and a pile of aluminum parts.

The Kscope was introduced in 1986. The fact that Ampex had a five-year head start, limited the Kscope sales. It was almost as capable from an effects standpoint as the ADO, and more capable as a facility wide system that could have channels of it assigned on the fly to different control rooms gave it a fighting chance. In reality the largest systems never had more than four channels.



Within a couple of years, the Group redid the control panel for the Kscope so that it appeared like a normal production switcher panel. It was called the Kadenza. Both the Kscope and Kadenza were digital composite systems. Again, that is video where the color, or chroma information and the monochrome or black and white information was mixed and processed together. The world was already leaning towards component, keeping the two sets of info separate. The bottom line was that component made for much better-quality video.

An advancement with the Kadenza was that it would accept 8-bit parallel digital video directly into and out, whereas the Kscope only accepted analog video. With the ability to accept parallel digital video (thick cables with a pair of conductors for each of the 8 bits) Kadenza could be the Group's first digital switche

with its thick cables never took off except in very niche situations

The Kadenza was sort of a hybrid between a DVE and a switcher. It could combine up to five Kscope channels with conventional switching capabilities. Expanding on the multiple control panels accessing a common pool of channels, the Kadenza allowed several control panels to access any combination of channels. NBC used the Kadenza at the 1988 Olympics.

As mentioned the initial plan was to involve enough state of the art hardware, which was controlled by firmware, so that eventually the software would catch up and completely match or surpass the ADO. From the beginning the software folks ran most of the project, and in a few ways the hardware was not fully developed, it generally evolved based on the software groups perceived needs.

In 1989 the Groups second DVE entered service, the DPM-100 (Digital Picture Manipulator). It was geared for smaller markets and production situations and came with a greatly lower price. That year the Group introduced its last analog switcher, called the Diamond.

3000/4000 GVG's first Digital Switchers

While the Kadenza, in a way, was the Groups first digital switcher, it was really an outgrowth of the Groups first DVE, the Kscope. It was also meant to be a post-production switcher. In response to Sony's introduction of their DVS-7000 the Group went to work on a competitive project. To do this quickly and efficiently they took the Kscope architecture and interfaced it with a more traditional control panel.

Up until Sony entered the switcher fray, people thought GV was eclectic, now some customers were starting to think GV was just weird. The reason for this was that as mentioned the world was leaning towards component video, and Sony was the leading pioneer on this path. Grass Valley, which was now at least thinking digital, still held on to what was known to them, composite video.

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First GVG "digital" switcher

The 3000 was a big step forward for the group as it no longer required the thick multi-conductor video cables, the digital video into and out of it traveled on a single coax cable, just like traditional analog video did. It was a clean sheet design, and it was designed to directly take SMPTE259 signals, the standard definition Serial Digital Interface (SDI). But these were not the component digital flavor that the Sony 7000 handled, but composite digital signals. Whereas the Kadenza could take composite parallel signals, known as SMPTE244, the 3000 would handle composite SDI over a single coax cable. The SDI standard could handle both the 143 Mb/s composite, and the 270 Mb/s component signals. The higher bit rate that component consumed down the coax cable than composite did was an indication of the superior quality that component brought compared to composite.

Today it is component video from camera to your home receiver. In the late 80s not all were sure that component would win the day. Many thought that like NTSC, and PAL analog formats, where chroma and monochrome are mixed, would be a straighter approach forward. CBS, like GVG, took a contrarian approach to the concept of digital video and pushed for composite digital. CBS had vigorously fought against the original NTSC color approach in the early 50s. Now they had differing opinions on how digital should proceed. In fact, in 1988 a standard for recording digital composite was issued, and that format became known as D2.

When it came time to launch the 3000. A

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was that the Group still was not fully committed to digital, let alone, which flavor. The company was still contemplating another analog switcher, as that was its comfort zone. While digital video makes somethings easier, somethings it did not. The design of analog filters and mixers were not in the first category. Both composite and component digital reduce video to a number sequence. Often that meant that mixing and filtering often involved mathematical processes. The Group had to end up using ASICS (Application Specific ICs) in their design. An expensive and time-consuming process. As already mentioned, a problem GVG had in designing ASICs was that instead of the most advanced modeling tools they used tools that Tektronix already had.

While the 3000 was the first GVG switcher that employed multiple microprocessors, there was much disagreement with how they were being used in a hierarchical manner. Many thought that from a processing standpoint the switcher ended up being under powered. This was born out after its launch as customers were not happy with the 2 to 3 frame delay for a source being selected on the control panel and the switcher cutting to it. This ended up hurting the production of a "People's Choice' award show that greatly angered CBS. Part of the problem was that some in the Group thought they were building a post-production switcher, and that the company was not talking to customers early on. As development went on the company needed to reposition the 3000 as their flagship offering. Something it could not do well. The market, and finally the Group itself realized that it was late to digital and had to deliver something competitive soon.

When the 3000 showed up at NAB in 1991 it required five hidden Compaq 386s to make it appear to work. The rouge worked well enough that a high-ranking Sony official looked at the switcher and exclaimed it was the switcher they should have built. Little did he know.

It turned into a software project the likes of which the Group had never seen before. There were 16 software engineers and only four hardware engineers working on it, Bruce Rayner, John Apt, Richard Bannister, and Brian Dunbar. Bannister had his hands full developing the ASICs that the switcher required. Sophia Day was the project manager. All the technical folks involved were surrounded by constraints stemming from waiting too long to realize where the indu

complaints that the project kept changing course, not only from management, but from the engineers involved also.

When the GVG 3000 shipped it was 95% complete. The problem was how do you deal with the 5% that's left with the customers staring over your shoulder? This is exactly what happened with the 300, and now the 3000. Sony now appeared to be the leader in the very area that had defined the Group. This was the first of the Grass Valley Company's nadirs.

1993 - Del Yocam, then President of Tek presenting an engineering award to Richard Bannister

Immediately the Group went back to the drawing board and went to work on the future, a clean sheet digital component switcher. They even had Dave Hershberger design the Groups own SDI transceiver chip set. Richard Bannister was this project's Program Manager. Bannister was a veteran of the hybrids, the 300, Kscope and Kadenza, and the 3000. While this project went far better than the 3000 it launched in 1992 with reliability problems.

The company was in dire straits from 1991 through 1993. In 1994 Tektronix sent down Dan Castles to straighten the situation out. He flew into San Francisco and got on a company plane for a 45-minute flight to Grass Valley. There was also another passenger on the flight. Dan asked his fellow traveler what was bringing him to visit the Group. He said he was with NBC in New York, and he said that he was going there to rip the current GV President a new asshole. Then he asked who Dan was. Dan said, "I'm Dan Castles, and I guess I'm getting a new asshole." NBC had committed to the 4000 switcher and it wasn't going to be ready as promised.

The next day at the meeting Dan said to the NBC guy, "We got an hour, here's all the people who are involved. If you want to go "New York" on them, go ahead, but it won't make any difference." That settled the visitor down a bit, and he simply asked if [illegible] shipped anyway. Engineering said it was at 95%.

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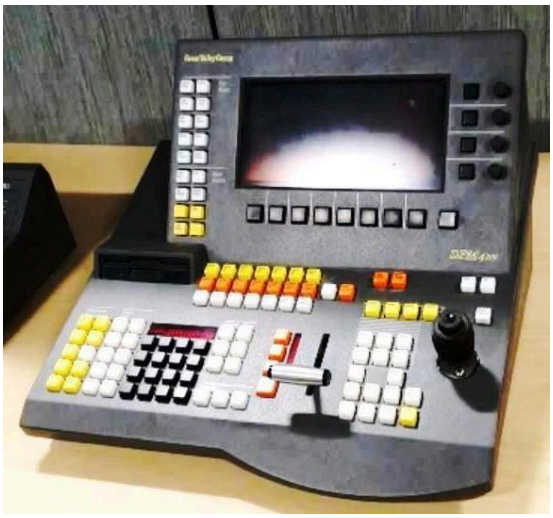
For the first six months that the 4000 was being shipped, Dan apologized to customers and put action plans into place.

Fox was doing one of their first big events, the World Cup. They were doing a dry run for Rupert Murdoch, and as he walked in the switcher went down. If it had been a real show, it would have been a disaster. So, engineer John Gerowwas was shipped back to babysit that switcher during that event. He couldn't do anything, but he was there for someone to beat up.

Once the issues were fixed the 4000 became a very popular switcher. The Kalypso was the follow on to the 4000.



The last stand alone DVE control panel. Soon DVE's were no longer stand-alone devices. They became a part of the switcher, as did the still store.

In the mid'90s Tektronix and the Group found itself defending too many market segments, and most of them not well. It was now facing increased competition in it&aois;s switcher, router, and as we will see a bit later, now in the video server markets. Both Tek's test equipment and the Groups video equipment had high capital development costs in hardware and in the user interface. Tek was starting to think it was not getting the return it wanted from Grass Valley. At one point there were even questioning if the Group was an asset in decline.

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Providence Site

Back in December 1982, the Group bought a second site, 160 acres, which was known as the Providence Mine site, after a mine complex that lied underneath. At the time, the Group was still experiencing rapid growth, and besides some 2000 employee

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equal number. Yes, in the early 80s the Group envisioned a future with 4000 employees in the area. The new site had several advantages. It was 500 feet from a main water line, and adjacent to Nevada City's wastewater plant. It had easy freeway access and was still secluded at the same time, lending itself to the campus-like environment GVG maintained at the Bitney site. Another plus was that when customers came to visit, the new site was much closer to hotels/motels, restaurants, bars, etc.

Executive Vice President Dave Friedley signs documents to enter into a contract of sale for the purchase of approximately 118 acres of land adjacent to Nevada City. Looking on are (l to r) Vice President of Finance and Planning Greg Fenner (holding the deposit check), Nevada City attorney Richard Ellers, Facilities Manager Ken Myers, and TEK attorney Norman (Eric) Jorgensen.

The best laid plans - Instead of growing the Groups size in the area. The opposite happened. Tek completely changed course, and instead of using the new site as a growth site, it became over time "the" site. By 1996 the Bitney Springs site had been emptied out. The total local employment went from almost 1000 at Bitney Springs in the early 80s, to a peak of 1200 in the area in the late 80s and then started a slow but continuous decline to around 550 at the turn of the century. After a number more purchases by outsiders and emancipation in 2015 the remaining 200 people still employed locally by the company moved into a 41,000 square foot building that was originally owned by the only spinoff the company ever had.

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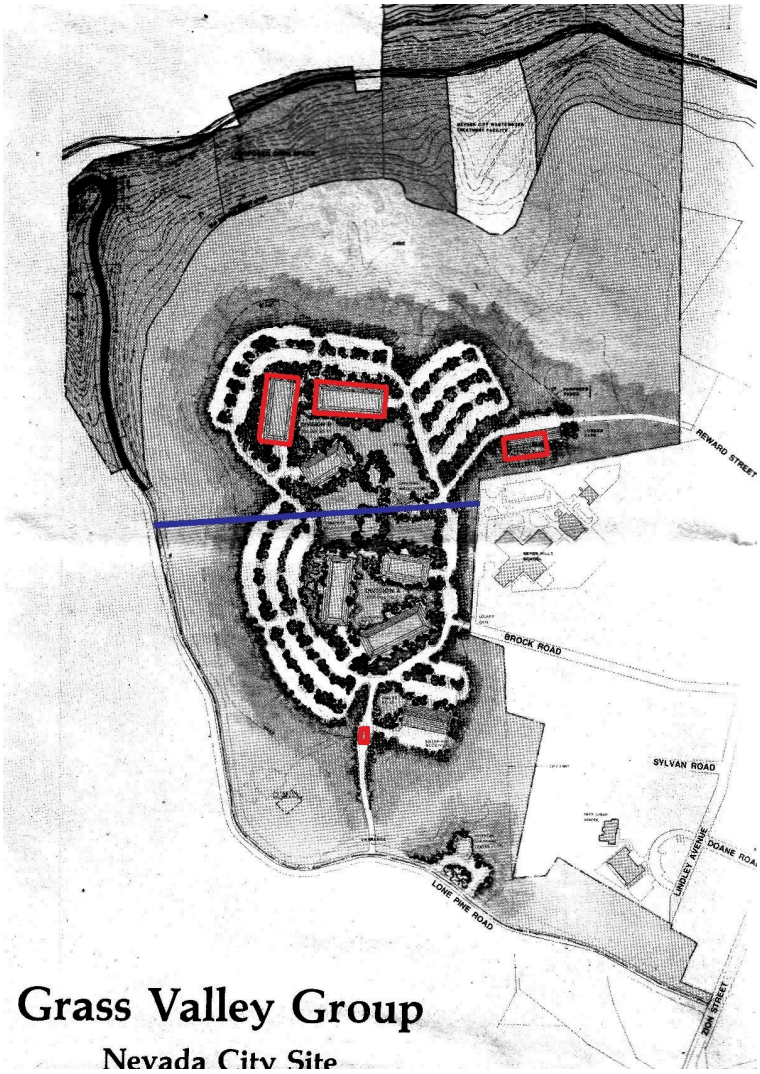

Only four of the nine planned buildings (red) were ever built. One of those four was a guard shack. The blue line depicts the southern portion of the site, which was sold off in 2000.

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