DOE/EE/15637--TK

FEMA

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Mail Stop 5E-052
Washington, D.C. 20585

March 5, 1996

RE: January - December 1996 Technical Progress Report
Instrument No. DE-FG01-95-EE15637, ERIP Invention 637

Dear Lisa,

Although the field testing and demonstration work ran into the first two weeks of January, those activities and results are covered in the previous Technical Progress Report. Most of the last quarter was spent in a designing and planning mode. The distractions of tax filing also soaked up some time.

The enclosed SF-272 is self-explanatory.

Here is a summary of activities and accomplishments, according to the statement of work in our contract:

Task 1:

3. Review the design with a safety engineer and insurance company...

We reviewed the 6-row machine on February 1st with Bob Gordon of Sentry Insurance and Safety Engineer Jim Morris.

The principal point of concern is the "stuffer disk". This is the most unique part of the implement, and the concern is that someone may ride on the machine to watch it work. If someone gets a shoe or pant leg caught on one of the engaging teeth or driving lugs of the stuffer disk, the disk could pull the person under. The stuffer disk is "guarded by location", which means that it is in the middle of the implement and no one should be near it when it is turning. We discussed the idea of putting a shield over the stuffer disk, but thought it would be counter-productive because a shield may invite people to ride on the machine, thus exposing them to other obvious dangers of riding on a farm implement (such as getting run over by the disc bedders). Another problem with placing shields over the stuffer disks is that they would impede service and cleaning tasks, hence many farmers will remove them (with a cutting torch, if necessary).

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The bottom line is that we must discourage people from riding on the implement. While not riding on implements is a well know caveat in agriculture, we must warn people of the non-obvious danger posed by the stuffer disk. We will do this by placing a warning label on the rear of each and every plow unit. This label will tell what the hazard is, how to avoid the hazard, and what the consequences of not heeding the warning can be. These consequences will be shown graphically with a figure of a person being plowed under by a stuffer disk.

Another warning label will relate to a pinching hazard on the scraper for the stuffer disk. The scraper and stuffer teeth form pinch points which could injure a finger while the operator is cleaning the stuffer disk (when working in wet conditions). A warning label on the scraper will advise operators of this hazard, show how to avoid it, and the consequences of not heeding the warning.

The Farm Equipment Manufacturers Association (FEMA) has a tillage safety council at work developing standardized warning labels for tillage implements. We will watch for the output of this council and will adopt standardized warning labels wherever they are appropriate for this implement.

Bob Gordon advises that most claims will result from highway accidents. We are in compliance with all standards on reflectors, Slow Moving Vehicle (SMV) emblem and warning lights. SMV's can be problematic as many farmers see them as a nuisance and will discard them. We plan to affix each SMV to a tool box on the implement. I have already acquired 30MM ammunition boxes for this purpose. They are the same height as an SMV and are slightly wider. This box will hold all of the spare parts required for routine upkeep of the machine and should prove handy enough that no farmer will discard it.

The operators' manual is instrumental in safety. The manual must address all of the safety issues relating to the operation, service, repair, and transport of the implement. We will incorporate the parts book into it to reduce the likelihood that farmers will discard it. A metal pocket inside the 30MM ammo box will hold the manual in a weather-tight location on the implement. The manual will come inside a zip-lock plastic bag for enhanced durability.

The warranty is also instrumental to safety. The registration card will require signatures from both the dealer and purchaser to the following effects:

DEALER'S SIGNATURE INDICATES:

- Equipment was properly assembled as directed by manufacturer.
- Equipment was tested functionally and operates properly.
- Purchaser was instructed in safe and proper operating procedures.
- Warranty was explained to purchaser.
- Purchaser was given operator's manual.

PURCHASER'S SIGNATURE INDICATES:

- Acceptance of equipment, fully assembled.
- Receipt of operator's manual.
- Clear understanding of warranty.
- Receipt of instructions on safety equipment.
- Receipt of instructions on safe and proper operating procedures.

This formality requires both the dealer and purchaser to acknowledge their safety responsibilities.

Each implement will be assigned a serial number and identified with a data plate or label affixed to the tool frame. The serial number will also be stamped in the tool frame.

While safety is an essential issue which must be addressed before any machines are sold to farmers, you will see in the enclosed PERT chart that this is not on the front burner at the moment. The critical path of the PERT chart appears to be in getting the machines produced, and if we don't get any built we will not have to worry about this issue.

I have began the upgrading of computer equipment required to generate the warning labels and operators manual / parts book. The computer is a Macintosh Performa 6300CD. I have acquired copies of Adobe PageMaker 6.0 and AutoCAD Release 12. As UA faculty, I can purchase software at the campus bookstore for about one-half to one-third of street prices. A graphics package such as Adobe Illustrator and a postscript laser printer will also be required for the work.

Task 2:

4. Field test the prototypes...

You have a copy of Lyle Carter's energy report on the two Pegasus machines. The same data are presented in another way in the enclosed report, showing the potential energy savings from plowing under whole cotton stalks. This report will be published in a 1996 field station report by the UA College of Agriculture. The "Cotton Report" is a compendium of all UA and USDA research in cotton in and relating to Arizona.

I have followed up with most of the farmers who tried the prototypes. Most have planted wheat after using the implement, and all who have done so are pleased with the results. Some will grow cotton after the Pegasus. None of this cotton has been planted yet. For the most part, seedbed preparation work has proceeded without any problems. One farmer re-listed his fields after the Pegasus and in some rows the lister pulled some old tap roots back up out of the soil. This is a little unsightly, however the tap roots are decomposed enough that they should not cause any problems. The overall feedback from farmers who have used it is very positive.

There are always those who resist change. In Extension work we call them the "intellectually reticent". One farmer predicted that his neighbor's wheat would die after planting behind the Pegasus (the wheat is doing fine). I'm not sensing a sales opportunity there.

Task 3:

The work involved between now and next fall is mind-boggling. I am very worried about being able to get it all done, especially with a full-time job getting in the way. The plan is for me to resign from the University in the fall to pursue this full-time, however if there are no products to sell leaving the University is not feasible.

In an attempt to get a handle on this, I have purchased a copy of MacProject Pro and am learning how to tackle these scheduling and project management issues. There is little or

no time to waste, and I hope this planning will be a worthwhile investment of time and money.

I would like to direct your attention to the enclosed PERT chart titled "Pegasus Schedule, April - September 1996". This is an early draft without any dates, times, costs, or resources yet assigned to the tasks.

Engineering Drawings: I have rebuilt the plywood mock-up of a row unit according to all of the desired changes noted in the last TPR. The next task is to get these changes incorporated into engineering drawings which a manufacturer can bid from and build to. Generating these drawings is a discipline in itself and I did not want to tackle it myself. None of the job shops in Tucson I visited were both able and willing to do this (too busy making stuff for the mining companies). The person I found to make the drawings is Pete Hermann, the CAD program director and instructor at Pima Community College. This is a part-time project for him, so it is not moving as fast as I would like, but at least we are making progress. He has taught me a lot about what is involved. Some of the drawings will be complete next week, and I will send copies of those to the potential manufacturers so they can begin working on their bids. Finishing all of the drawings may take until mid-April.

These drawings cover the major fabricated parts of the implement, including the tool frame, plow units, moldboards, stuffer disk, stuffer disk hub assembly, and clearing disk assembly. Drawings of some of the minor parts will follow later and should not impede the bid process. These minor parts include the disc bedder bearing hangers and disk scrapers. Wayne Coates and I have reviewed the Pegasus carefully for any needed changes, and the only one is that the disc bedder bearing hangers need some beefing up. The weakness is shown in Figure 14 of the last TPR. Cracks in the paint show where the flag plate has been flexing with soil forces. We will place a gusset at about 90° to those cracks, and the bolts will be repositioned slightly. This is not a change which will involve any significant differences in manufacturing cost.

Mr. Hermann is making the drawings in AutoCAD. This will facilitate design changes later on. The AutoCAD drawings can also be used in the parts book.

THE UPPER LOOP OF THE PERT CHART:

None of the manufacturers I have talked to want to build the jigs and fixtures. There are some potential problems in this part of the manufacturing process, and we will have to resolve them here in Tucson. One problem is that parts from the jigs must be field tested before the production run begins. If there is something wrong with the jigs, it is best to find out before the production run.

Another reason for doing this in Tucson is that the jig-making process can run parallel to the bidding and financing tasks, thus compressing the schedule and giving us a shot at getting the production run done in time to have something to sell in the fall. This process will probably not involve making the jig for the tool frames, since that is a reasonably mistake-proof part and the likely manufacturers already have suitable tool frame jigs.

Build Left & Right Row Units From Drawings: This is the first step in making the jigs. We must have pieces to build the jigs around. Bonita Steel Builders will do this work.

Build Jigs Around New Left & Right Row Units: Bonita Steel Builders will do this, and it will involve jigs for:

1. The top section of the plow units, essentially the plow beam and attaching points to the tool frame. This one jig will be used for both left and right row units, since this part is the same for both.

2. The lower section of the right plow unit. The top section from the above jig will be mated to the three large plates which make up the lower portion of the unit.

3. The lower section of the left plow unit, as above.

4. Right stuffer hub assembly.

5. Left stuffer hub assembly.

6. Right clearing disk assembly.

7. Left clearing disk assembly.

8. Leading disc bedder bearing hanger.

9. Trailing disc bedder bearing hanger.

We are now working on cost estimates and I will be submitting an SF-270 in the near future.

Build Left & Right Row Units From Jigs: This is an essential part of the process to prove the jigs. Again, Bonita will do this work.

Field Test New Units: This process will generate four new row units, all of which will be fitted to the four-row implement we built last fall. While it is impossible to test the implement in cotton in the next few months, we do have the opportunity to test it in wheat stubble. A farmer in Marana wants to try the Pegasus to plow under wheat stubble in preparation for a grain sorghum crop. This will be in June. While we will not be testing in cotton stalks, we will know how soil and trash flows through the implement.

Jigs Verified: Hopefully we will reach this milestone in June.

Ship Jigs to Manufacturer: By this time we should have contracted for the manufacturing.

THE CENTER PATH OF THE PERT CHART:

This is most likely the critical path with little or no slack time. It is definitely the one I am most concerned about.

Bids From Manufacturers for Whole Goods & Parts: The most likely candidates for the manufacturing are:

Bigham Brothers, Inc. in Lubbock, Texas (Sandy Kimball, President). His quality is excellent, and I think he realizes how the Pegasus can be instrumental in generating demand for his products in the west.

Nikkel Iron Works, Inc. in Shafter, California (Jack Nikkel, President). Nikkel's products are known for high quality. Everything I have seen from them is excellent. The factory is a few miles from the USDA-ARS Cotton Research Station. Lyle Carter has known him for 40 years and says that his reputation both as a person and manufacturer is outstanding. Nikkel has some old products which are nearing the end of their life cycles, and he needs to get into something new. His location in the San Joaquin Valley could prove to be excellent; it is the largest potential market for the implement.

There are other possible manufacturers, however I am not sure of their capabilities or quality. Some have never made farm implements before, which could be very problematic at this early stage. Bonita Steel Builders will also bid for the work, but I'm afraid they won't be in the ballpark on the costs.

I will ask for prices on both the whole goods and parts. Usually, implements are shipped "broken down" for freight economies, that is, to fit more on a truck bed. I will specify that the implements be shipped assembled and shipped standing on their front ends, using special shipping fixtures we will provide. If shipped without the warning lights or SMV's the implements will be 46.5 inches wide when standing on end. Two will fit side-by-side on an eight foot wide truck bed, hence the freight costs should be reasonable.

There are a number of reasons for shipping the implements assembled. First, we won't have to worry about dealers mis-assembling the implements, a common problem with new and unique implements. Second, the product arrives in better shape because it doesn't arrive as a bunch of parts that have been clanging together on the truck bed. Finally, we will have to make some direct sales in the Phoenix area to get local dealers interested, and we do not have the time or facilities to assemble implements. John Deere now ships all of their planters assembled for the first two reasons and it has worked out well for them.

Stock Sales: Our cash flow challenges will become clearer in the near future, and we will sell additional stock to meet those needs.

Floor Plan w/ Transamerica Commercial Finance Corporation (TCFC): This is a FEMA group flooring plan. The rate is about prime plus two, which is a little expensive. However, there are some benefits. One is that TCFC will authorize the manufacturer to build however many implements we will have made and guarantee payment on delivery. Thus the manufacturer does not have to worry about looking to Pegasus for their money. Another benefit is that TCFC will file UCC's on the dealers and protect our security interest in the implements in the event that a dealer goes belly-up. We have to agree to take possession of any repossessed implements.

This task is dependent on having bids from the manufacturers and our being able to collateralize the loan (stock sales). I will probably also be putting my house on the line.

Contract for Manufacturing: This will involve lawyers on both sides and TCFC. One of our principal concerns is that we get the implements delivered in good time to do our marketing. We will want to specify some very steep discounts or other penalties for late delivery.

Production Run: Once launched, this should not take more than a few weeks. We are probably only going to build ten or twelve the first year.

THE LOWER LOOP OF THE PERT CHART:

Set Prices & Trade Discounts: Setting prices is dependent on getting firm prices from whomever is going to make the implements. I have reviewed trade discounts with the John Deere dealer in Tucson. Most trade discounts plus early payment discounts add up to 25%. Usually, there is an additional discount for volume orders. We are planning to go with 20% trade + 5% early payment + 5% volume (five or more implements per order). These are very typical for the industry.

Dealer Contract: FEMA is advising us members that we should have dealer contracts to protect our interests. We have had a lawyer draft a contract, but have kept this on the back burner due to other critical path issues.

Dealer Orders: It appears at the moment that the primary dealer the first year will be M&S Equipment Co. in Coolidge. My prediction is that the owners of the firm will place a very conservative order. I will then work with their salesman to soak up that entire order with early orders from farmers, and then challenge the owners to order more to avoid missing more sales opportunities.

A problem is that there has been some internal monkey business going on at M&S which concerns me a lot. Their salesman who has worked with me is liable to leave in disgust. Without an interested and motivated salesman, I'm not confident that any dealer can be successful with a new product such as the Pegasus. If this individual leaves, I will have to reconsider whether to do business there. We may have to do some direct sales in the region, these would all be early orders with farmers we have demonstrated with.

We also need to consider how many to order for direct sales in the Phoenix area. There is more financial risk than when working through dealers, but our margins on direct sales will be about twice as much. We will definitely have to do some direct sales to get the ball rolling in that region and get area dealers interested.

This task generates the total number of orders we will place with the manufacturer.

OTHER BRANCHES OF THE PERT CHART:

These other tasks do not worry me as much as the ones leading up to the production run. I have pretty good control over these, and none appear to have any long lead times.

Design & Build Shipping Fixtures: These are the fixtures which will facilitate shipping the implements assembled and standing on their front ends. They will be simple fixtures of rectangle section and angle iron. They will attach to the three point hitch of the implement using the implement's linch pins. Two pieces of rectangle section will be access holes for a forklift for easy and safe lifting. The fixtures will be about 4' x 6' x 1'. They will be designed to nest and tightly stack for shipment back to the factory after they are removed at the dealer lot. We will have them made in Tucson.

Ship Fixtures to Manufacturers: First the fixtures will be tested for fit-up to our four-row and six-row prototypes, then shipped to the factory.

Ship to Dealers: The sooner the better. I would be willing to take early delivery and eat the interest expense for an extra month or two. With early shipment, we would park them on the dealer lots where farmers will see them. The latest acceptable delivery date would be November 1.

Complete Safety Review & Warning labels: We know what needs to be done. The main part of the task is to design the unique warning labels required and get them printed. Turnaround time from decal makers, if I submit the labels on a Macintosh disk file, is about two weeks.

Assemble Safety Equipment: The machines will be shipped without warning lights or SMV's. The SMV's will be on the 30MM ammo boxes, and a metal pocket inside will hold the operator's manual. This will require some sheet metal work, welding, painting, and attaching bolts. The lights will be a sub-assembly, ready to bolt in.

Install Safety Equipment: This will be done in most cases by the dealer, on the dealer lot. We will deliver those items to the dealer.

Affix Labels & Serial Numbers: We will do this ourselves. The serial number will likely be on a self-adhesive aluminum label, with the numbers typed into the soft aluminum. Before affixing this label we will stamp the serial number into the tool frame. The Pegasus logos and warning labels will be affixed at this time.

Operator's Manual & Parts Book: This will have to be reviewed by the safety engineer and the insurance company. I will develop the book, using the AutoCAD drawings and some photos for illustration. Once we have a camera-ready, we can have it printed in Tucson in a short time.

Warranty Registration Forms: Again, these will have to be reviewed for safety issues. They will be printed in Tucson.

Order Spare Parts: We will have to plan for parts needs and the cash flow that will be required.

Parts Inventory & Pricing: We may utilize one of the dealers as a parts depot, where we store parts without charge and they work out of our inventory without having to hold their own. Dealer trade discounts on parts will probably be 30%.

Promotion Materials: Salesmen find one-page brochures to be very useful when prospecting for sales. I would also like to get at least one advertisement in the Arizona Farmer, if time allows. The ad would have a sidebar which lists the dealers.

Pegasus Ready: We hope to reach this milestone by October. November will still work. December could be a disaster.

OTHER ISSUES:

Leaving the University: The amount of time this business demands is getting to be a problem with my earning a paycheck at the UA. If we can secure enough firm orders for machines and are reasonably sure that we can get them built in time, I will resign in the fall. If not, I will have to stay on. Working two jobs is a purgatory.

for machines and are reasonably sure that we can get them built in time, I will resign in the fall. If not, I will have to stay on. Working two jobs is a purgatory.

Selling Guidance Systems: Assuming that I resign from the UA in the fall, Pegasus will become a dealer for the Acura Trak guidance systems. This is the guidance system I have been demonstrating with the Pegasus. It is clearly the best one on the market. We will be able to sell the Pegasus and Acura Trak as a package, and pick up a few bucks doing it. Acura Traks run $5,000 to $7,000 depending on options and we get a 20% commission.

The big selling season for Acrua Traks is in the spring (for listers, planters, and cultivators). This could be a way to fill in the off-season of the Pegasus and help keep the company afloat. There are also some benefits in prospecting for Pegasus customers in the off season.

As you can see, my plate is pretty full. The tasks involved are mind-boggling. I hope I don't end up needing all of the two year performance period of the contract. Two or three months from now we will have a pretty good idea of how this will unfold. If things go well, especially the parts about contracting for manufacturing and firm orders from dealers and farmers, I could resign from the UA in mid-summer and easily knock out all of the tasks that come after the production run.

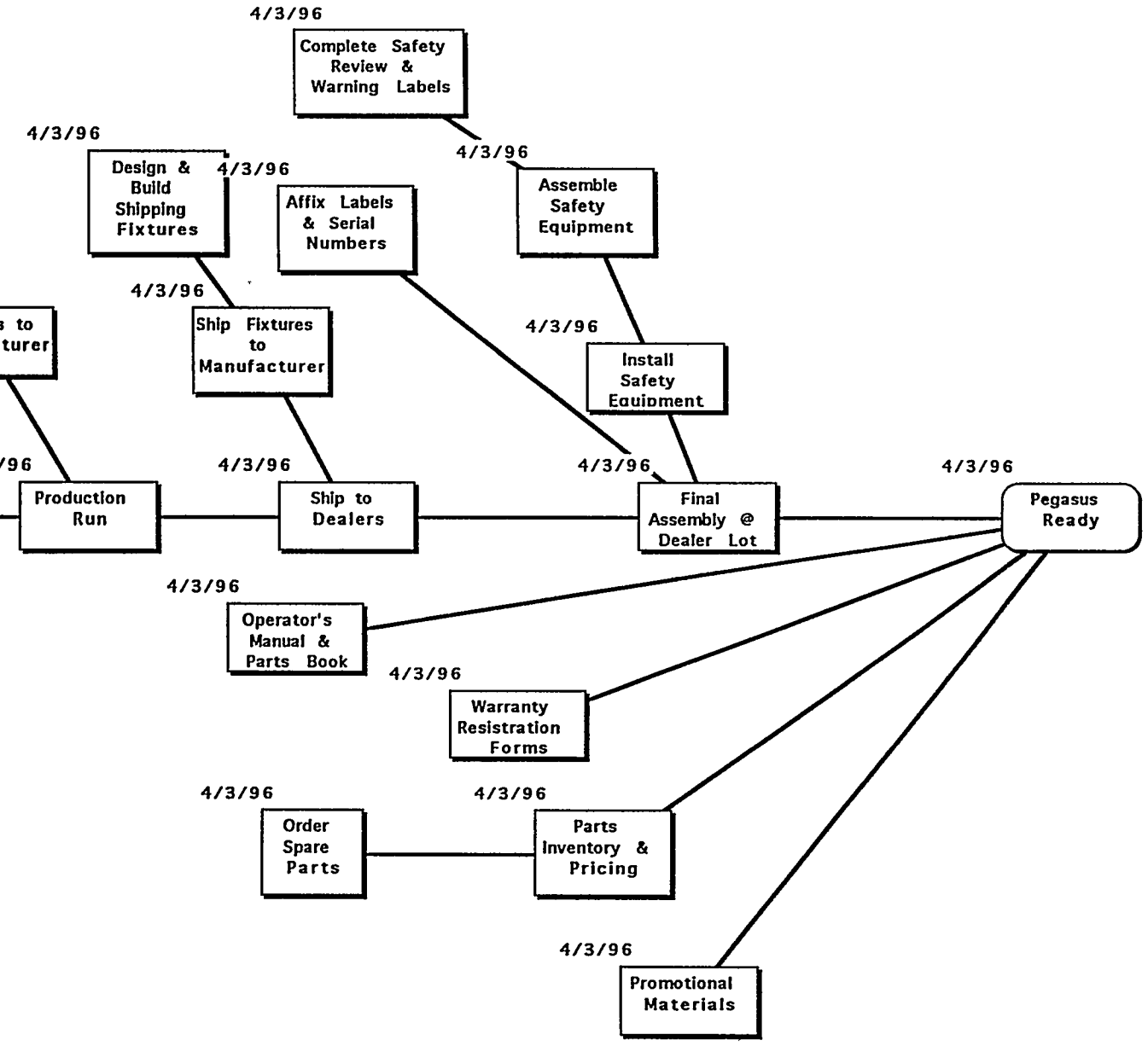
If you have any ideas, suggestions, or comments, let me know.

Sincerely,

Gary W. Thacker

Enclosures:

UA Cotton Report article on Pegasus energy use.
PERT Chart
SF-272 and supporting data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Complete Safety Review & Warning Labels
4/3/96
Design & Build Shipping Fixtures
4/3/96
Affix Labels & Serial Numbers
4/3/96
Assemble Safety Equipment
4/3/96
Ship Fixtures to Manufacturer
4/3/96
Install Safety Equipment
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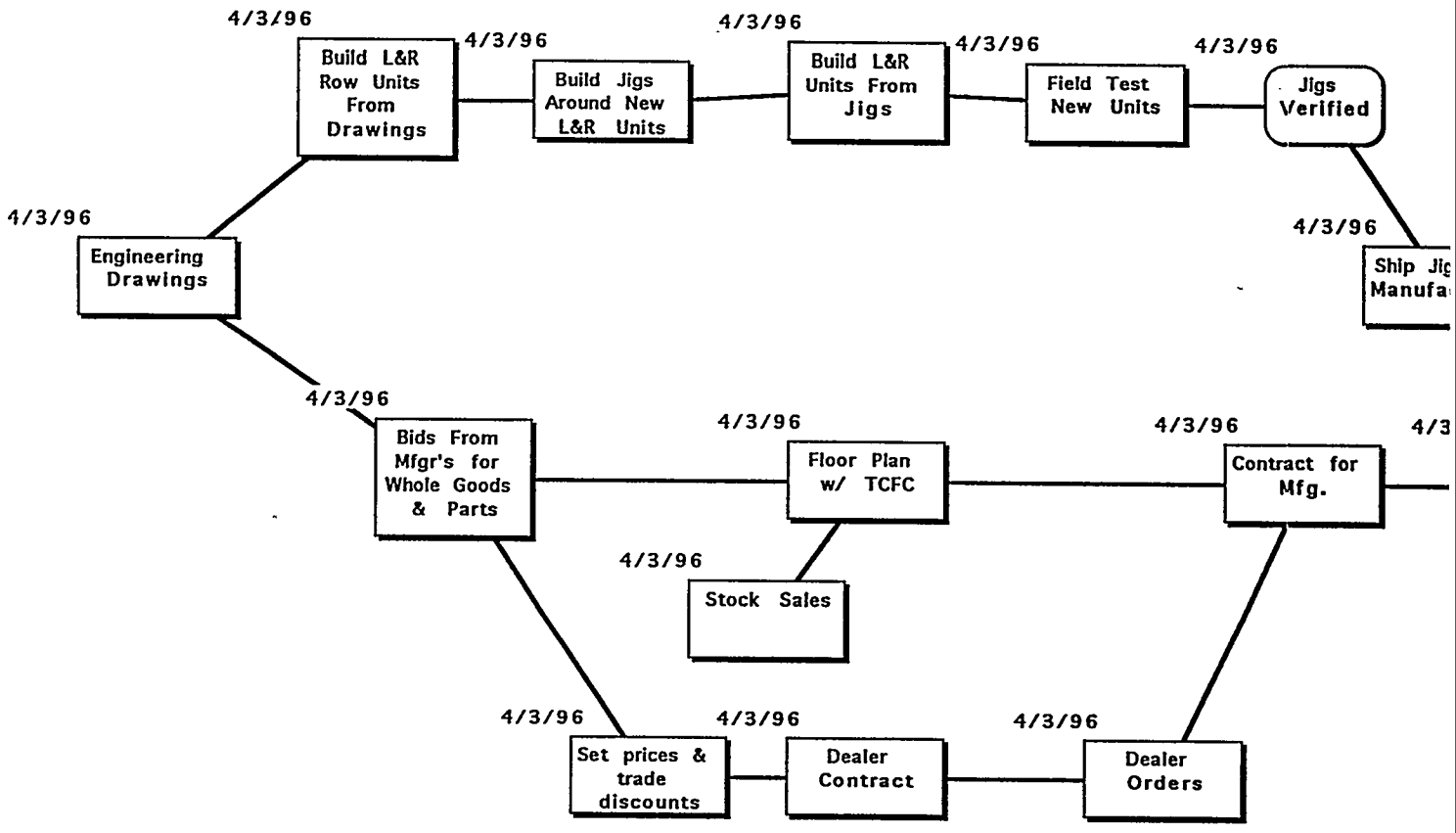
Production Run
4/3/96
Ship to Dealers
4/3/96
Final Assembly @ Dealer Lot
4/3/96
Pegasus Ready
4/3/96
Operator's Manual & Parts Book
4/3/96
Warranty Resistration Forms
4/3/96
Order Spare Parts
4/3/96
Parts Inventory & Pricing
4/3/96
Promotional Materials

Pegasus Schedule, April - September 1996



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