

the time of termination or decision not to add additional funds to the contract the contractor has not been paid for property purchased for use under the contract it is entitled to its possession. We find that appellant spent its funds for the Baird Flame Photometer, the Trinocular Microscope and the Friden Calculator; that it has not been reimbursed for those funds and that an equitable distribution under paragraph (d) of the LOCC requires that they be returned to appellant.

### III

#### Summary

We have found that appellant has failed to show impossibility of compliance with the requirement of paragraph (a) of the LOCC that it give notice to respondent of an impending overrun. Hence, the contracting officer acted within his rights in refusing to fund appellant's overrun.

Title to all special scientific equipment in issue here rests in respondent except for the three items for which appellant has not been reimbursed. As to those three items appellant is entitled to their ownership and possession. Insofar as appellant's appeal sought the return of those three items it is sustained.

Appellant is not entitled to payment in excess of \$309,240.00. As the contracting officer recognized in his final decision appellant's entitlement to that amount and denied only payments in excess thereof, his decision was correct. Insofar as appellant's appeal sought payment in excess of that amount it must be and hereby is denied.

#### — Footnotes —

<sup>1</sup> The criterion has since been raised to \$1,000,000.

<sup>2</sup> By another contract provision the contracting officer was substituted for the Office of the Comptroller of the Navy and subparagraph (d)(iv) deleted.

<sup>3</sup> ASPR XV, Part 3—"Principles for Determining Costs Applicable to Research and Development Under Grants and Contracts with Educational Institutions" is the DOD implementation of Bureau of Budget Circular A-21 with some minor modifications.

#### [19960] GENERAL DYNAMICS CORPORATION, ELECTRONICS DIVISION

ASBCA No. 14466. March 22, 1973. Contract No. N0bsr-77628.

#### Patents—Royalty Clauses and Rights

The government was not entitled to royalty-free licenses for five inventions it claimed where developed under a government contract because the inventions had been "reduced to practice" prior to award of the contract. The

inventions were found to have been basic to the contractor's innovative approach to the development of single sideband communications equipment, which had, in fact, influenced the government in making its award.

Sellers, Conner & Cuneo by Herbert L. Fenster with Martin LuKacher for the appellant. Vincent A. Cinquina, counsel, Paul V. Snow, Evan C. Revelle, John McCollough, and Stephen R. O'Neil for the government.

Opinion by Mr. Arons with Mr. Burns, Mrs. Burg, Mr. Solibakke, and Mr. Andrews, Jr., concurring.

This is an appeal from the final decision of the contracting officer dated 6 August 1969 determining that the Government has royalty-free licenses to practice five patented inventions which are said by the Government to be "subject inventions" within the meaning of the Patent Rights clause of the above contract. Appellant contends that the Government does not have such licenses on the ground that the inventions in controversy were conceived and reduced to practice prior to the commencement of appellant's performance under the contract. Although appellant claims that the five patents have been infringed, such infringement claims as such are not before this Board. The issue for resolution by the Board is whether the Government is entitled to the claimed licenses by operation of the Patent Rights clause in the contract.

#### Findings of Fact

##### *The Contract*

Contract N0bsr-77628 was a cost plus fixed fee research and development contract entered into between appellant and the Department of the Navy as of 16 June 1959. Under the contract appellant was required to design and furnish experimental models, mock-up models, and developmental models of the AN/URC-35 single sideband radio set and the AN/PRC-45 single sideband portable transceiver. By Modification 7 to the contract these equipments were redesignated AN/WRC-1() and URC-35() respectively. For convenience the contract will be occasionally referred to as the WRC-1 contract. All work was to be completed by 31 December 1962. The total estimated cost to the Government was stated as \$1,221,909.00. The contract schedule included the following provision entitled "COST SHARING":

"It is agreed that all costs for this contract to the extent that they are allowable as set forth in Clause 4(a) of the General Provisions shall be shared seventy-five percent (75%) by the

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Government and twenty-five percent (25%) by the Contractor. The Government shall have the same rights under this contract as if the Government had borne one-hundred percent (100%) of the cost. It is understood and agreed that the Contractor's undertaking to share costs of the contract is limited to \$221,000.00, exclusive of applicable General and Administrative expense."

The total estimated cost was increased by successive amendments to the contract. Modification No. 12 dated 4 December 1964, the last of the amendments which affected funding, increased the total estimated cost exclusive of fixed fee to \$1,952,765.00.

The contract specifications set forth various performance requirements to be achieved in the design and development of the equipment. In paragraph 1 of the specifications entitled "SCOPE", the goals to be attained were generally set forth as follows:

"1.2 *Classification.*—This equipment shall be of the following types as specified in the contract.

"1.2.1 *Type I—AN/PRC-45()* shall be designed primarily for employment as a general purpose voice communications transceiver. The equipment will be used in limited duty, semi-portable applications such as in amphibious landing craft, shipborne vehicles and for use by beach-landing parties. Equipment handling involves high-impact shock, continued bounce and vibration. The equipment will be used primarily by non-electronic type personnel.

"1.2.2 *Type II—AN/URC-35()*, shall be designed primarily for use aboard Naval ships and at Naval shore stations as a general purpose communications radio set. The equipment will be used in a continuous duty service and shall be designed for versatility, a high order of stability, simplicity of operation and maximum of reliability. The equipment shall be a transmitter-receiver having a common reference frequency source. The receiver shall contain provisions for use of an alternate frequency source."

Paragraph 3.2.2 provided that:

"Each equipment shall be so designed and constructed that it will be capable of 5000 hours of continuous operation, under the varied and severe conditions of Military service, without overhaul and with a minimum of maintenance..."

Paragraph 3.3 further provided in part that:

"Simplicity of design, operation and maintenance is of primary importance, but shall not detrimentally affect the reliability of the equipment. The equipment shall be designed for economical production."

Other paragraphs specified particular performance requirements including indication of certain environmental factors, e.g., capability

of the equipment to be transported at altitudes up to 45,000 feet (non-operating).

The General Provisions of the contract included the standard Patent Rights clause which provided in pertinent part as follows:

"(a) As used in this clause, the following terms shall have the meanings set forth below:

"(i) The term 'Subject Invention' means any invention, improvement, or discovery (whether or not patentable) conceived or first actually reduced to practice either—

"(A) in the performance of the experimental, developmental, or research work called for or required under this contract; or

"(B) in the performance of any experimental, developmental, or research work relating to the subject matter of this contract which was done upon an understanding in writing that a contract would be awarded;

"*provided*, that the term 'Subject Invention' shall not include any invention which is specifically identified and listed in the Schedule for the purpose of excluding it from the license granted by this clause.

\* \* \*

"(b)(1) The Contractor agrees to and does hereby grant to the Government an irrevocable, nonexclusive, nontransferable and royalty-free license to practice, and cause to be practiced by or for the United States Government, throughout the world, each Subject Invention in the manufacture, use and disposition according to law, of any article or material, and in the use of any method. No license granted herein shall convey any right to the Government to manufacture, have manufactured, or use any Subject Invention for the purpose of providing services or supplies to the general public in competition with the contractor or the Contractor's commercial license in the licensed fields."

### *Origins of the Dispute*

During a conference held in May, 1964, attended by representatives of appellant and the Navy, the matter of patented inventions connected with appellant's work under N0bsr-77628 was discussed. Nine patented inventions were identified as applicable to that contract. Of the nine inventions on the list, appellant conceded that four were licensed to the Government under the terms of the contract. Appellant maintained that the other five inventions were conceived and reduced to practice during appellant's development, prior to the award of N0bsr-77628, of a single sideband transceiver called the SC900A. Government personnel present at the conference were not aware of the SC900A, and indicated that in their opinion those five inventions were made during appellant's fabrication of experimental and develop-

mental models of the WRC-1 (Tr. 5-37, 43, 59-60).

Whether or not the Government had licenses to inventions connected with appellant's single sideband radio development work became an important question because the Navy had decided to procure production quantities of WRC-1 radio sets. At the time of the May, 1964 conference appellant was already performing under one production contract. On 24 February 1965, following a competitive solicitation, Bendix Corporation was awarded a second production contract for WRC-1 radio sets. By letter dated 17 March 1965 (Rule 4, Tab 6) appellant informed the Navy that in its opinion the manufacture and sale of WRC-1 radio sets by Bendix would result in the infringement of the five patents relating to the WRC-1 development effort but which, in appellant's view, were not licensed to the Government under N0bsr-77628. Following an investigation conducted by the patent counsel for the Navy Bureau of Ships (Mr. Warfield), the Navy informed appellant in a letter dated 16 November 1965 (Rule 4, Tab 7) that, in the Government's view, the five patented inventions providing the basis for appellant's allegation of infringement were finally conceived and/or first actually reduced to practice during the course of appellant's performance under N0bsr-77628, and that the Government accordingly had royalty-free licenses to practice those inventions. Appellant was asked to execute confirmatory license agreements or present further evidence supporting its position

that the five inventions in controversy were conceived and actually reduced to practice prior to the award of N0bsr-77628.

Appellant did not execute the license agreements, but decided not to raise the issue again until after Bendix made deliveries under its WRC-1 production contract. By letter to the Navy dated 13 February 1968 (Rule 4, Tab 9), appellant restated the basis for its infringement claim. Attached to the letter were the patents issued by the United States Patent Office on the five inventions at issue, and affidavits executed by named inventors and others which described the circumstances relied upon by appellant in contending that the five inventions were conceived and reduced to practice prior to the award of N0bsr-77628. Extracts from engineers' notebooks and photographs were also attached. By letter to appellant dated 25 March 1968 the Navy again requested that confirmatory licenses be executed, having decided that appellant failed to prove actual reduction to practice prior to the award of N0bsr-77628. After a further exchange of correspondence in which the parties restated their respective positions, the contracting officer issued his final decision which gave rise to this appeal.

#### *The Patented Inventions*

The following table lists the patented inventions involved in this appeal. All of the data in the table has been extracted from the patents issued by the United States Patent Office.

Patent Number *	Description	Date Patent Application Filed	Date Patent Issued
3,054,057	Digitally-Tuned Transmitter-Receiver	13 July 1960	11 September 1962
3,060,329	Automatic Gain Control Generator for Receivers	9 November 1959	23 October 1962
3,061,742	Stable Transistor Frequency Changer having a Stable Multi-vibrator with Synchronizing Pulse Input	28 December 1959	30 October 1962
3,132,310	Phase-Locked Oscillator	29 January 1960	5 May 1964
3,151,301	Linear Radio Frequency Power Amplifier having Capacitive Feedback	16 June 1960	29 September 1964

\* From time to time in this opinion these patents will be referred to by their last three digits.

*The SC900A Program*

As indicated above, appellant contends that the five patented inventions in controversy were conceived and first actually reduced to practice during its development of the SC900A transceiver prior to the award of N0bsr-77628.

During the summer of 1958 appellant decided to embark on the development of a single sideband transceiver. In comparison with AM transmitters and receivers, single sideband equipment was considered to be more efficient in terms of energy transmitted and, further, such equipment allowed twice as many stations to use a given spectrum within a frequency range. Single sideband equipment had been previously produced by other manufacturers. Appellant's intention was to develop a unit which would allow appellant to demonstrate its competence in the field to potential customers. In particular, appellant was aware that the Army and Navy were contemplating the award of development contracts for single sideband equipment intended for military use. In order to increase the likelihood of its obtaining the award of these contracts appellant decided that its single sideband unit would include advances in the state of the art. Thus at the outset of appellant's single sideband program an inventive effort was envisaged (Tr. 1-29-30, 42-44, 51, 107; Exh. A-2).

Although appellant performed some preliminary study work during the summer of 1958, progress was first made in late September or early October 1958, after appellant decided on the amount of corporate funds to be committed to the project. About \$250,000 were originally allocated, and \$171,622 were expended when the project was stopped in July 1959 following the award of N0bsr-77628 (Tr. 1-94, 107, 118; Exh. A-3; Rule 4, Tab 23). \$74,500.00 were spent during January and February 1959 (Rule 4, Tab 21). Appellant initially intended to fabricate two units. Due to budgetary restrictions only one unit was actually fabricated. The second unit was considered desirable in order to conduct demonstrations for customers; i.e., one unit would receive signals transmitted by the other unit. However, since one unit could be fully tested with instruments, its operability could be fully demonstrated from an engineering standpoint (Tr. 1-113-114, 119; Exh. A-8).

Appellant's single sideband project was performed by a group organized within the Communications Laboratory of the Stromberg-Carlson Division of General Dynamics Corporation. The Stromberg-Carlson Division was apparently renamed the Electronics Division in 1964 or 1965, although the record is unclear on this point. The single sideband group was supervised by Mr. Schwittek, an

electrical engineer hired by appellant in May, 1957, partly to develop a capability for appellant in single sideband communications equipment (Tr. 1-27-28, 92). After corporate funds were committed to the project, Mr. Schwittek recruited fifteen to twenty engineers, many of whom had considerable experience in single sideband communications while working for other companies (Tr. 1-47-49). The program was viewed as being of a "crash" nature, requiring the hiring of very capable personnel (Tr. 1-49). As of 26 November 1958 appellant estimated completion of the first of the two then-contemplated models by 31 May 1959 (Exh. A-5).

The development process took the form of a group effort in that several engineers were involved in the development of individual modules or subsystems which eventually comprised the SC900A. Novel or inventive ideas were conceived by single individuals, but others were involved in determining the best methods for implementation of the ideas (Tr. 2-22-24). After an inventive solution to a problem was conceived, a paper analysis was performed to determine whether the idea could be implemented with known components. The feasibility of the idea was then tested by way of a "breadboard" which included specific circuit elements such as transistors or vacuum tubes, capacitors and resistors wired together. After the breadboard was successfully tested, the circuitry to be actually included in the radio was diagrammed and fabricated as a "brassboard" which was a more complete breadboard. The brassboard for each module was to be configured if possible in the size and shape intended for inclusion in the radio. Breadboard testing was intended to determine whether the circuitry actually possessed the attributes of the inventive idea sought to be implemented. Brassboard testing included, in addition, some testing of finer design characteristics. Following brassboard testing, different modules or components were connected to determine whether the attributes of each were compatible with those of others. Final testing was performed on the entire transceiver system. Tests at all stages were qualitative in the sense that all of the necessary attributes of components, modules and the system were scrutinized at representative frequencies among the 28,000 frequencies which the SC900A was intended to accommodate. For example, measurements were taken at three frequencies—one high, one low and one medium (Tr. 2-34-39).

*Nature of the Evidence Presented*

In support of its position in this appeal appellant relies primarily on the testimony of

six engineers who participated in appellant's single sideband (SC900A) project. This testimony was presented at the hearing in this appeal, held in June, 1972. Appellant also submitted for the record engineers' notebooks, drawings and other data which were used to support the testimony. Appellant also relies on its proposal dated 12 May 1959 (Rule 4, Tab 36), which led to the award of N0bsr-77628, as indicating the extent to which the practicality of the inventions had been demonstrated through testing at the time the proposal was prepared.

The Government presented no witnesses at the hearing with a view to contradicting the testimony of appellant's witnesses. The Government's only witness was its patent counsel (Mr. Warfield) whose technical qualifications in the field of single sideband communications were not established. He had no familiarity with the nature of the inventions at issue in this appeal prior to May, 1964 (Tr. 5-36). His testimony was received, over appellant's objection, only as it related to how he was instrumental in formulating the Government's position in this appeal. The Government relies primarily on documents including extracts from the notebooks of appellant's engineers, which, in the Government's view, establish that appellant did not demonstrate the practicality of the inventions, as described in the claims of the patents, until after it had undertaken performance under N0bsr-77628. The Government also relies on appellant's proposal, suggesting that the proposal indicated that appellant had a considerable amount of work to perform before the concepts reflected in the patents would be implemented in any practical fashion. The Government also points to what it considers to be inconsistencies and vague recollections in the testimony of appellant's witnesses as detracting from the weight which should be accorded that testimony.

#### *Value of Engineers' Notebooks as Evidence*

At the time engineers working on development projects were employed by appellant, or shortly thereafter, they were issued notebooks which remained the property of appellant. Notebooks, or parts thereof, issued to four of the six engineers who testified at the hearing were received in evidence (Exh. A-13, Harrison; Exh. A-19, A-20, Dalglish; Exh. A-24, Clark; Exh. A-26, Van Sandwyck). The notebook of one other engineer who participated in the SC900A program, but who did not testify (Mr. Garceau), was also received (Exh. A-14).

At the top of the first page of each notebook, the employee to whom it was issued signed and dated a receipt which provided that any original ideas recorded in the notebook became

the property of appellant and that the employee would not divulge such ideas outside the company without first obtaining the approval of the Patent Department or the head of the employee's Division. On the same page instructions for use of the notebook were set forth in their most pertinent part as follows:

"The purpose of engineering notebooks is to make a permanent record of engineering work done. Notebooks are issued by the Patent Department to employees doing original design work.

"Records of engineering work shall be kept in sufficient detail to enable other engineers in the same field to follow the course of the work by reading the notebook. . . .

"Each page shall be dated and signed at the bottom. . . .

"If original ideas are developed in the course of the work which might be patentable, the inventor should discuss the work with other employees who are sufficiently familiar with the field to understand the work, but who are not involved in the invention. The people with whom the invention was discussed shall be listed in the notebook. The notebook entries concerning possible inventions and any other papers relating thereto and referenced in the notebook . . . should then be witnessed in the spaces provided on the pages of the notebook. An inventor's draft should be made out and transmitted to the Patent Department as soon as possible."

At the bottom of each notebook page there was a space for the signature of the employee to whom the notebook was issued and the date on which he signed. Below that signature line there were two signature blocks entitled respectively "Witnessed operation (obtain two signatures)" and "Read and understood (obtain two signatures)." Examination of the notebook pages received in evidence indicates that for the most part appellant's engineers signed the pages on which data appears. However, the provisions for recording the signatures of persons who witnessed the operations producing the data, or persons who read and understood the data, were ignored in virtually all instances.

Mr. Harrison, a named inventor on four of the five patents involved in this dispute, testified that typical of most engineers he recorded in the notebook only that information which appeared significant or represented an end result. He considered the notebooks as maintained solely for the edification of the Patent Department and were of no use to the engineers in their work, which was to create hardware and document that hardware in engineering drawings. According to Mr. Harrison, any information placed in his own notebook was the result of pressure exerted by

the Patent Department. In his view it was seldom that an inventor would recognize that his work had the promise of being patentable (Tr. 2-43, 3-5-10). Mr. Harrison's views were substantially shared by Mr. Van Sandwyk, a named inventor on the automatic gain control patent (Tr. 5-20). The Garceau notebook (Exh. A-14) was maintained in what Mr. Harrison considered to be extraordinary detail (Tr. 3-50). Of the 74 pages in the Garceau notebook signed and dated by Mr. Garceau prior to 1 July 1959 none recorded any signatures of persons who witnessed operations or read and understood the data recorded on those pages.

We find that the engineers working on appellant's single sideband project did not maintain their notebooks strictly in accordance with the instructions contained therein and that appellant's management did not insist upon strict maintenance of these notebooks as a condition of employment. However, there is no evidence that the data recorded in the notebooks did not accurately reflect data which was developed. In view of the testimony of Mr. Harrison on the maintenance of engineering notebooks, which was not contradicted, we are unable to find that the recording of data therein on an occasional basis, or the absence of the signatures of witnesses, detracts from the reliability of the recorded data as evidence of appellant's accomplishments as of the dates indicated on the notebook pages.

We now consider the individual patented inventions at issue in this appeal and the work performed by appellant in connection therewith.

#### *Patent No. 3,054,057—Digital Tuning*

The principal witnesses who testified on this invention were Mr. Harrison, one of the named inventors, and Mr. Clark, who also worked on the digital tuning portion of the single sideband transceiver under development. Neither of these individuals was employed by appellant at the time of the hearing in this appeal. Moreover, Mr. Harrison testified before the Board's Hearing Member pursuant to a subpoena issued by the Federal District Court for the Western District of New York under the authority of 5 U.S.C. § 304.

Early in the SC900A project members of the group assembled by Mr. Schwittek considered that single sideband equipment with a digital tuning capability would represent a marked improvement over similar equipment then commonly tuned in an analogue fashion (Tr. 2-21). Through inventiveness and group discussions certain novel digital tuning techniques were conceived. The scheme conceived allowed the selection of individual digits representing the desired frequency using a series of knobs on

the equipment. Thus the human element involved in attempting to fine-tune to a desired frequency through operating one knob in a rotary motion would be eliminated (Tr. 2-9-10).

The digital tuning as conceived was accomplished through the operation of several synthesizers, each of which represented the range of frequencies to be obtained through the manual dialing of individual tuning knobs to designated digits, or numerals. Each digit was to perform a separate function (Tr. 2-21). In the implementation of the digital tuning concept selected for the SC900A there were four knobs and four synthesizers, for tuning at one megacycle (mc) increments, 100 kilocycle (kc) increments, 10 kc increments and one kc increments. The mc synthesizer would select one of twenty-eight megacycle portions of the two to thirty mc band which the SC900A was designed to accommodate. The other synthesizers would select 100, 10 and one kc increments as appropriate within the mc range selected. The outputs of these synthesizers were combined together by the operation of mixers to form the single frequency desired (Tr. 2-6, 7). A frequency standard assured the accuracy and stability of the frequency selected (Tr. 2-3, 4, 3-43). The digital tuning scheme also included an r-f amplifier which precluded the entrance of undesired signals and amplified the desired frequency (Tr. 2-8).

The frequency selection technique employed for use in the SC900A was that eventually described in the patent. In the patent itself the capability of digitally tuning to any one of 28,000 channels spaced at one kilocycle intervals from two to thirty megacycles was described as "one system constructed according to this invention." (Rule 4, Tab 9-057 patent). On the basis of Mr. Harrison's uncontradicted testimony and the patent itself we find that the invention which was patented consisted of a frequency scheme or a series of techniques involved in achieving digital tuning. We further find the invention was not dependent on any particular mechanical structure or circuitry, and that particular hardware depicted or described in the patent represents clarification of the invented techniques, or a method or methods of implementing those techniques. The digital tuning invention, particularly the synthesizer techniques, and the phase locked oscillator invention, to be discussed below, had uses other than in radios (Tr. 2-114-115). In short, the concepts were patented, not particular hardware or methods of implementation (Tr. 3-26, 33-34, 52, 69, 76-77).

The ideas behind the digital tuning invention were conceived, in a permanent sense, during the fall of 1958 (Tr. 3-53). Circuits were then mathematically calculated. By the middle of November, 1958, Mr. Clark had calculated the

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tuning technique which was ultimately implemented in breadboard and brassboard stages of the digital tuner development process (Tr. 4-98; Exh. A-24). By 12 December 1958 a tuning circuit breadboard consisting of soldered components had been constructed. No attempt was made at achieving a complete switching network (Tr. 4-99-100). Experiments using test equipment were performed to find errors in the 2-4 mc band, the area of the desired frequency spectrum in which the greatest number of errors were likely to occur (Tr. 4-117, 119-120). The data indicated that the type of circuit employed would obtain the complete range of frequencies required (Tr. 4-100-101). The circuit was essentially the same as that eventually employed in the SC900A and as that described in the -057 patent, except that the one kc portion was not implemented. Mr. Clark, who recorded the data, testified that in his opinion the breadboard demonstrated that the design of the circuit was workable and practicable (Tr. 4-101-102, 115-119; Exh. A-24).

During January and February 1959 different elements of the digital tuning scheme were breadboarded. By 1 February 1959 appellant had tested and found workable a circuit capable of selecting one frequency out of ten required frequencies and sufficiently rejecting the other nine frequencies. The type of circuit tested as of that date was described in the -057 patent as a method of tuning to one kc frequencies (Tr. 2-69-71; Exh. A-13, p. 16). The breadboard model of the one kc synthesizer was found capable of tuning to one kc increments on or about 25 February 1959 (Tr. 2-82). However, not all of the approximately 100 different circuits to be included in the synthesizer were implemented, and the breadboard was put aside for further work. According to Mr. Harrison, once the feasibility of a circuit design was proven, he would put the circuit aside until the feasibility of other elements of the equipment was established (Tr. 2-83). The breadboard of the one kc synthesizer which was tested at that time was actually used in system tests of the SC900A, to be discussed below (Tr. 2-82).

Circuitry implementing the 10 kc and 100 kc synthesizers was also tested during February 1959. The tests demonstrated that the synthesizer outputs reflected what had been calculated (Tr. 2-78). The 10 kc and 100 kc synthesizer circuitry as thus tested was similar to that actually employed in the SC900A and referred to in the -057 patent (Tr. 2-77). The record is unclear as to the status of the megacycle synthesizer during January-March 1959. However, we find, on the basis of uncontested testimony by Mr. Harrison, that the megacycle synthesizer used in the SC900A and described in the patent was built and func-

tioning satisfactorily at the time appellant's proposal was submitted (Tr. 2-28-29, 127-128).

Appellant's proposal (Rule 4, Tab 36), prepared for the most part during April 1959, depicted work which appellant had accomplished up to that time on digital tuning. That work was reflected through test results which were displayed on various pages of the proposal. For example, the figure on page 3-9 of the proposal showed a curve indicating the maximum errors in a digital tuning circuit tested during the early spring. The circuit was tested between 1.5 and 6 megacycles. Good results were shown, indicating the workability of the digital tuning invention (Tr. 2-124-125, 4-112-113, 133-134). On page 3-16 of the proposal there appeared an advance printed circuit model of the one megacycle synthesizer that was utilized in the SC900A (Tr. 2-28-29). According to Mr. Harrison, the megacycle synthesizer depicted on that page represented one method of implementing the basic concepts shown in the -057 patent (Tr. 2-29). Pages 3-22 and 3-23 of the proposal included figures which illustrated techniques used in connection with the one kilocycle synthesizer and which were referred to in the -057 patent (Tr. 2-67-69). Page 3-20 of the proposal included a figure illustrating techniques used in connection with the 10 kc and 100 kc synthesizers as ultimately employed in the SC900A. These techniques were also referred to in the -057 patent (Tr. 2-73-77).

In addition to work on the synthesizers appellant was also working on the r-f amplifier, the frequency standard, the frequency translator and mixing scheme, all of which were referred to in the -057 patent. The frequency standard was developed by Mr. Van Sandwyk early in the SC900A program. It was breadboarded and found to be workable by 5 January 1969 (Tr. 2-129, 4-141-145, 170; Exh. A-26). The frequency standard developed by Mr. Van Sandwyk was described in appellant's proposal (Tr. 4-142; Rule 4, Tab 36, pp. 3-27-30). According to Mr. Harrison, the frequency translator and mixing scheme were operational at the time the proposal was prepared. However, Mr. Harrison did not observe any testing of those aspects of the digital tuning mechanism at that time. From the record presented we find that by late May or early June 1959 the translator and mixer circuitry referred to in the -057 patent, and as installed in the SC900A, had been tested and found workable (Tr. 2-127).

The r-f amplifier, using transistors, was built in preliminary form by early April 1959. Drawings of the r-f amplifier and frequency translator, originally made on 10 March 1959, were revised as of 28 April 1959 (Tr. 4-107-109). The revised drawings reflected the final form of the



r-f amplifier and translator module as they were installed in the SC900A (Tr. 4-108; Exh. A-25). These modules were tested prior to their inclusion in the SC900A chassis, and found to be workable (Tr. 4-108).

As of 1 June 1959 all of the inventive concepts embraced in the -057 patent were implemented in brassboard form and turned over to the engineers in charge of integrating the SC900A and conducting system tests (Tr. 2-92). Each of the brassboard modules comprising the digital tuning mechanism had been tested qualitatively in the sense described above (Tr. 2-92). In Mr. Harrison's opinion the brassboard tests proved that the concept of digital tuning and frequency scheme described in the patent were usable in solving problems associated with single sideband radio, and that circuits employed in the modules were workable and usable (Tr. 2-93). From Mr. Harrison's viewpoint as an engineer, the testing of individual modules was far more significant than a test on the entire radio system. He testified that performance characteristics of components, such as the r-f amplifier, could be tested with greatest accuracy only if they were individually tested. When testing such modules as part of the entire radio, it would not be possible to determine whether the measurements made were indicative of the operation of the module under test, or of other parts of the radio. He did believe, however, that if each module was tested completely for its characteristics, meaningful tests could then be conducted on a group of them (Tr. 3-57-59). The testing on the SC900A system as a whole will be discussed below.

#### *Patent No. 3,132,310—Phase-Locked Oscillator*

The evidence in support of appellant's position with respect to this patent was again presented primarily through the testimony of Mr. Harrison, the sole named inventor on the patent. Much of the work involved in implementing this invention was performed by Mr. Garceau, who was under Mr. Harrison's direct supervision (Tr. 2-53).

The -310 patent was related to the -057 patent in that it represented a method of obtaining the frequencies necessary to fulfill the digital tuning function (Tr. 2-29). The one megacycle synthesizer included an oscillator which, through a novel phase-locked loop, locked each of the eighteen different frequencies generated in half-megacycle increments to the accuracy of the frequency standard (Tr. 2-5, 12). The phase locking technique was described in the patent through circuits shown in a block diagram (Figure 1). The patent also included, as Figure 2, a circuit diagram of a specific implementation of the general technique shown in

Figure 1 (Tr. 3-74). On the basis of Mr. Harrison's uncontradicted testimony and the patent itself, we find that the invention which was patented consisted of the phase locking concept or technique, not specific circuits which might be used to implement that technique. The circuitry was included in the patent description for explanatory purposes (Tr. 3-74, 174).

The phase locking concept was breadboarded by Mr. Garceau on the basis of a sketch drawn for him by Mr. Harrison on or about 4 February 1959 (Tr. 2-61-63; Exh. A-14). The circuit built up by Mr. Garceau generated a spectrum of frequencies required for locking the megacycle oscillator. The basic frequency scheme thus developed was later implemented in the SC900A. By 16 April 1959 test data taken from the breadboard indicated that the phase locking technique was workable and usable in the megacycle synthesizer (Tr. 2-101; Exh. A-14). Due to the characteristics of a particular quartz crystal in the oscillator being tested, the oscillator did not function properly at the lowest frequency (Tr. 2-101-102). This problem was cured by 22 April 1959 through the use of clipping diodes in the oscillator (Tr. 2-101-103, 3-152-153). Appellant's proposal, under preparation at that time, included references to the locked oscillator circuit developed by Mr. Garceau (Tr. 2-63-67). A diagram on page 3-14 of the proposal was identical in every significant way to the block diagram in Figure 1 of the patent (Tr. 3-73-74; Rule 4, Tab 36).

Following successful testing of the breadboard Mr. Garceau then built up a similar circuit on a printed circuit board. Tests indicated that the circuit did not operate under many conditions (Tr. 2-104). In Mr. Harrison's opinion, the difficulties encountered did not indicate that the phase locking concept was unworkable. He testified, based on the data, that the layout of the circuit board or the characteristics of particular components used were the most likely source of difficulty (Tr. 2-104-105). In effect, some redesign was called for not in the patented techniques but in the characteristics of particular components or circuit elements used to implement those techniques (Tr. 2-102, 105-106). On or about 15 June Mr. Harrison took measurements from Mr. Garceau's printed circuit board and found no significant problem in the circuitry (Tr. 2-106).

As of 15 June at least two modules of the oscillator had been built. The module installed in the SC900A used components taken from the breadboard, which had operated satisfactorily (Tr. 2-107). However, the experience with the printed circuit board module indicated that work had yet to be performed in finding ways in which the circuit would be operational with

a variety of different components. Mr. Harrison testified that the success of the breadboard, as with any breadboard, was based on an element of luck. In his view, the breadboard proved the workability of the phase locking concept. What remained to be solved were problems associated with the implementation of the concept using different components available on the market, an example of what he referred to in his testimony as the vast difference between proving that a design fulfills its function and developing a final production item (Tr. 2-104, 107-108; Exh. A-14). Mr. Garceau continued to work on the oscillator circuit until at least the middle of August 1959 (Tr. 3-153-155).

*Patent No. 3,061,742—Frequency Changer*

Appellant's evidence in support of its position with respect to this patent was again presented primarily through the testimony of Mr. Harrison, the sole inventor named on the patent.

The invention embraced in this patent involved a specific type of oscillator which instead of producing sine wave outputs, produced a pulse type output, locked to a pulse type input (Tr. 2-118). The type of frequency divider or changer initially used in appellant's single sideband development project produced a square wave output. This wave shape had to be modified in order that proper frequency spectrums could be generated (Tr. 2-118). Mr. Harrison's invention in effect produced the shortened pulse needed to generate the spectrum in a fashion considered to be an improvement over the method previously used (Tr. 2-119). On the basis of Mr. Harrison's testimony, which was not contradicted, we find that the workability of the inventive concept was not dependent upon a specific physical form (Tr. 2-143).

The invention was conceived by Mr. Harrison during early fall, 1958, when, with appellant's permission, he was working as a consultant to Star Headlight and Lantern Company. Appellant was entitled to obtain the rights to any of Mr. Harrison's inventions made pursuant to the consulting arrangement. Star Headlight at that time had a requirement for a light flasher for highway use which put out a short pulse of energy and was very efficient. The circuit devised by Mr. Harrison as the implementation of his invention proved workable and satisfied Star Headlight's requirement (Tr. 2-120-121).

In April or May 1959 Mr. Harrison brought one of the printed circuit boards used to implement his invention at Star Headlight to appellant's plant and connected it in place of the frequency dividers then being used in the single sideband project. Tests indicated that the

circuit devised by Mr. Harrison would replace several of the more cumbersome and intricate circuits then being employed as frequency dividers (Tr. 2-119). The tests were performed on a divider module and some of the synthesizer modules. The results indicated that the circuit would perform frequency division and generate a frequency spectrum (Tr. 2-120).

The frequency divider circuit devised by Mr. Harrison was not incorporated into the printed circuit board which was installed in the SC900A. It was decided that the existing circuitry did not present a limiting factor in the operation of the SC900A (Tr. 2-119-120). We accordingly find that the frequency changer invention was not involved in the SC900A system tests, to be discussed below. In Mr. Harrison's opinion the circuit was established to be workable and practical for use in the single sideband radio by the module testing performed in April or May 1959. From the evidence presented we find that the circuit tested at that time was essentially the same as that created for and used by Star Headlight and Lantern Company (Tr. 2-120-121). From a reading of the -742 patent, and Mr. Harrison's testimony, we further find that the invention embraced by the patent was not restricted to use in single sideband or other particular types of equipment.

*Patent No. 3,060,329—Automatic Gain Control*

The evidence in support of appellant's position with respect to this patent was presented primarily through the testimony of Mr. Van Sandwyk, one of the named inventors, who built and tested the circuit depicted in the patent (Tr. 4-139, 5-22). Mr. Van Sandwyk terminated his employment with appellant in 1963 (Tr. 4-136). Mr. Harrison, who was another named inventor on the patent, also testified on this subject.

The automatic gain control scheme embraced by the -329 patent was devised as a method to overcome gain control problems associated with the peculiarities of single sideband signals (Tr. 2-30, 4-138-139, 145). Gain control was essential in the receiver portion of the radio in order to overcome variances in the amplitude of the signal produced by pauses between syllables or words when someone is speaking (Tr. 4-138-139). As employed in appellant's single sideband project, the patented scheme covered a method of generating automatic gain control voltage. However, the scheme was not limited to such use. The concept has proved useful to provide other types of control voltage (Tr. 2-115-116).

The automatic gain control (AGC) invention described in the -329 patent involved the rapid discharge of capacitors after a predetermined,

relatively long hang time. The rapid discharge was essential in order to avoid desensitization of the radio, rendering it incapable of receiving a very low-level signal (Tr. 2-30-31, 4-148-149; Rule 4, Tab 9, -329 patent). The automatic gain control scheme was described through circuitry depicted in Figure 2 of the patent, and the operation of the circuitry was described in Figure 3 (Tr. 4-148-149). However, on the basis of testimony by Mr. Harrison, Mr. Van Sandwyk, and the patent itself we find that the invention which was patented consisted of the AGC concept or scheme, not the particular circuitry depicted in the patent for explanatory purposes (Tr. 3-174, 175, 5-12, 16-17; Rule 4, Tab 9, -329 patent).

By the middle of January 1959 Mr. Van Sandwyk had designed an AGC circuit which was identical to that shown in Figure 2 of the patent except for the absence of two diodes which were shown in the patent (Tr. 4-149; Exh. A-26). Hardware implementing the design was built in the form of a small circuit board by 27 January (Tr. 4-150-152). The hardware was tested at that time and the results indicated that the desired operations were obtained (Tr. 4-152-154). In Mr. Van Sandwyk's opinion, the automatic gain control as developed and fabricated on that circuit board was demonstrated to be workable for the purpose intended (Tr. 4-153, 158). The same circuit board was later installed in the SC900A at the time of systems integration and testing (Tr. 4-152-153).

Appellant's proposal included several oscillograph pictures indicating the operation of the AGC circuit designed and built by Mr. Van Sandwyk in January 1959 (Tr. 4-136-137, 177; Rule 4, Tab 36). The photographs indicated that the AGC equipment eventually incorporated into the SC900A was working at the time the proposal was prepared (Tr. 1-74, 2-130, 5-5). Figure 4 of the patent, which depicted the gain control circuit developed in response to a typical received message, was based on similar oscillograph pictures (Tr. 5-3-4).

Appellant's proposal also included, on page 3-46, a schematic diagram identical in all material respects to the design prepared by Mr. Van Sandwyk in January 1959, and identical to the circuit depicted in Figure 2 of the patent with three differences. One difference which Mr. Van Sandwyk characterized as "absolutely insignificant" involved a change in the connection of one capacitor (Tr. 4-154-155). The second difference again involved the absence of two diodes shown in Figure 2 of the patent. These were clipping diodes, used for protecting transistors which at that time had not been perfected to avoid breakdown at relatively high voltages (Tr. 4-155, 5-9-10). At the time the proposal was prepared, appellant anticipated

that better transistors would be obtained (Tr. 5-11). At relatively low voltages, the diodes were unnecessary. In Mr. Van Sandwyk's opinion, which is not contradicted in the record, the absence of the diodes from the schematic diagram did not amount to a significant difference between that diagram and Figure 2 of the patent (Tr. 4-150-155). We find that the inclusion of the diodes in the patent related to the implementation of the patented AGC scheme at relatively high voltages, given the state of transistor technology at that time (Tr. 4-150).

The third difference between the proposal schematic and Figure 2 of the patent was the absence from the patent of two resistors included in the schematic. On the basis of Mr. Van Sandwyk's testimony we find that the absence of those resistors had no significance as far as the operation of the circuit was concerned (Tr. 4-149-150).

The inventor's draft, prepared as a basis for appellant's patent application, indicates that a test sample of the AGC generator was constructed between March and June 1959 by Mr. Kohlen on the basis of Mr. Van Sandwyk's design (Rule 4, Tab 25). Mr. Kohlen was a technician who assisted Mr. Van Sandwyk in building the AGC circuit. However, at the time the test sample referred to in the inventor's draft was built, Mr. Van Sandwyk had been assigned a different task, unrelated to the AGC circuit (Tr. 5-25). We find that the test sample referred to in the inventor's draft was not the model of the AGC generator originally built by Mr. Van Sandwyk in January 1959. The record does not indicate the specific purpose for which the second model was built. We are unable to find that the test sample referred to in the inventor's draft differed in any significant respect from the original printed circuit board built by Mr. Van Sandwyk.

#### *Patent No. 3,151,301—Power Amplifier*

The evidence in support of appellant's position with respect to this patent was presented primarily through the testimony of Mr. Dagleish, an electrical engineer who, beginning in December 1958, worked on the power amplifier unit eventually installed in the SC900A. Mr. Nielson, who was in charge of integrating the SC900A subsystems, also testified on this subject. Mr. Nielson had previous experience in working on power amplifiers. Mr. Dagleish terminated his employment with appellant in 1961 (Tr. 3-80). The record does not indicate Mr. Nielson's employment at the time of the hearing in this appeal. Mr. Bettin, the sole named inventor on the patent, did not testify.

The invention embraced in this patent was a feedback system to reduce harmonic intermodulation distortion in a power amplifier (Tr. 1-86, 3-95). In order that a signal could be received with full fidelity by single sideband equipment a small amount of output power had to be fed back to the input. This "negative feedback" tended to reduce the distortion otherwise produced (Tr. 3-84-85). Negative feedback was a well-known concept. The novel feature introduced by the patented invention was the use of a capacitor bridge circuit in the input of the amplifier driver stage (Tr. 3-97-98, 138). The advantage of the capacitor bridge circuit claimed in the patent was a more uniform negative feedback over a frequency range (Tr. 3-138-139, 145; Rule 4, Tab 9, -301 patent). From the text of the -301 patent we find that the invention was not limited to the particular details of construction, materials and processes described for explanatory purposes.

Work on the power amplifier feedback bridge circuit conceived by Mr. Bettin began in mid-December 1958 (Tr. 3-87). By 10 March 1959 tests had been conducted on a negative feedback capacitor bridge circuit constructed in accordance with a circuit diagram dated 3 March 1959, drawn by Mr. Hesselberth, one of the engineers working on the power amplifier development (Tr. 3-81-82, 87-88; Exh. A-19, A-21). Measurements were made over the 1.8 to 2.6 megacycle range and good results were obtained (Tr. 3-89, 96). The circuit arrangement under test at that time was in all material respects the same as that depicted in Figure 2 of the patent (Tr. 3-97-98, 4-14-17, 70-72).

Mr. Hesselberth's diagram was revised on 17 March and 20 April 1959. Changes were made in the values of resistors and capacitors, and certain tubes were adjusted in order to obtain the desired output power (Tr. 3-118). Tests conducted in April indicated successful operation of the power amplifier using the negative feedback circuit (Tr. 4-20). Results obtained from those tests were set forth in appellant's proposal (Tr. 4-19; Rule 4, Tab 36). As of 3 April the major design goal of 100 watts output was attained within the 2 to 2.5 megacycle range (Tr. 3-122, 134). Testing at that time was restricted to this relatively narrow frequency range since not all of the coils were made (Tr. 3-120). In Mr. Dagleish's opinion, if the desired results were obtained from one coil, desired results would be obtained from similarly-designed coils used to accommodate other frequency ranges. (Tr. 3-130).

Appellant continued to conduct tests involving changes in the value of components in order to obtain the desired efficiency in the use of the power supply. The effort was to find the best compromise between extra capacitance on the power amplifier plate circuit and the

desired amount of feedback (Tr. 3-133-134). As of 11 June appellant had not quite reached the ideal trade-off, but had established the limits between which it would exist (Tr. 3-134). Moreover, by this time sufficient coils had been made to enable testing at other frequencies. The evidence establishes that by 12 June 1959 the power amplifier had been shown to operate successfully at frequency ranges of 8 to 10 megacycles, 14 to 16 megacycles and 28 to 30 megacycles, in addition to the 2 to 2.5 mc range (Tr. 3-100, 141-142, 4-73; Exh. A-20). We so find. The power amplifier was not tested, prior to the award of NObsr-77628, across the entire 2 to 30 megacycle frequency range intended for the SC900A (Tr. 4-73). The testing was qualitative in the sense discussed above. In Mr. Dagleish's opinion, which was not contradicted, the tests that were performed provided a good representative sampling of the power amplifier operation, and that further variations between the ranges tested were unlikely (Tr. 3-145-146). Mr. Nielson similarly testified that from an engineering point of view the successful operation of the power amplifier was proved by the tests covering the high end, the low end and center of the desired frequency spectrum. In his view the absence of coils covering other frequency ranges was insignificant (Tr. 4-45-46).

#### *Systems Integration and Testing*

The introduction of individual modules and their installation into the SC900A chassis was accomplished for the first time by 25 April 1959. Mr. Nielson was in charge of this aspect of the SC900A development. His recollection of various events about which he testified was reinforced by the fact that his wedding date was 25 April 1959 (Tr. 4-20-21). By that date all of the modules were wired together in the chassis and functioning properly, although work continued thereafter on individual modules (Tr. 4-21). When Mr. Nielson returned from his honeymoon, on 21 May 1959, the unit was torn down and an effort was being made to solve mechanical problems of remote switching in the r-f unit. These mechanical problems indicated poor design for the purpose of producing SC900A units in quantity, but did not affect the capability of the unit as wired up to demonstrate the workability of the inventions at issue in this appeal (Tr. 4-21-23).

By the end of May the individual modules were again installed and wired together in the chassis (Tr. 4-22). Except for the invention described in the -742 patent, all of the inventions at issue in this appeal, as implemented in various modules, were included in the SC900A system. Tests on the system were conducted in late May or early June (Tr. 4-82-84, 158). No

test plan was prepared and no test results were recorded (Tr. 4-55-56). In the opinion of appellant's engineers the system tests that were performed were of little or no engineering significance. The significant data, indicating that the system worked as intended, had previously been obtained through testing of individual modules or selected combinations of modules. The tests on the system as a whole were performed at the request of patent counsel and, further, in order to show that the radio could be demonstrated to potential customers who might be laymen (Tr. 1-172, 2-63, 79-80, 3-64, 4-56-58).

The system tests that were performed in effect demonstrated, from a layman's point of view, that the radio would play. The radio was operated in the transmit mode, with the signals monitored by a Collins receiver at the other end of the laboratory (Tr. 3-60). In the receive mode, the radio picked up broadcast signals off the air. The record does not indicate whether any single sideband signals were actually received. The radio was capable of receiving AM transmissions (Tr. 3-60-61, 4-83-84). As demonstrated, the equipment was not capable of being tuned in one kilocycle increments since the one kc knob was fixed. According to Mr. Harrison, if different crystals had been soldered in, a five minute operation, tuning could have been performed in one kc increments. We find that the absence of the particular mechanical linkage in the test model which prevented one kc tuning did not indicate that the digital tuning scheme included in the -057 patent was incapable of providing for tuning in one kc increments (Tr. 3-32-34).

The record in this appeal includes evidence of certain visits to appellant's plant made by Government representatives, at about the time of the SC900A systems integration and testing, for the purpose of observing the status of appellant's single sideband development project. Appellant had submitted a proposal to the Army Signal Corps with a view to obtaining a single sideband contract from that agency. From the evidence presented we find that Signal Corps engineers visited appellant's plant at various times prior to 12 June and were impressed with performance test results showing the feasibility of appellant's methods of solving problems then associated with single sideband transceivers (Tr. 1-78-82, 2-24; Rule 4, Tab 37). In the written evaluation of appellant's proposal prepared by the Signal Corps, dated 12 June 1959 (Rule 4, Tab 37), particular mention was made of the digital tuning scheme, the power amplifier system and the automatic gain control. The evaluation indicated that appellant had mastered certain problems in these areas, and was continuing to investigate possible approaches to solving other

problems. The Signal Corps evaluation does not indicate when the performance test data referred to was generated.

Mr. Harrison and Mr. Nielson testified that appellant's single sideband group was also visited by Navy representatives. No trip report or other document has been produced for the record indicating the purpose of the visit or what might have been discussed. On the basis of Mr. Nielson's testimony, which was not contradicted, we find that such a visit was made in late May or early June, and the SC900A was operated for them in the layman sense described above (Tr. 2-24-25, 4-31).

#### *Events Following Contract Award*

As of 16 June 1959, the date NObsr-77628 was awarded, much development work remained to be performed if the SC900A was to be economically mass-produced (Tr. 1-171). As of 11 June 1959, Mr. Schwittek recommended to management that appellant not furnish a quotation on SC900A equipment to prospective customers since in his view the future of such equipment was considered "nebulous" and depended upon appellant's success or failure in obtaining military single sideband contracts (Rule 4, Tab 22). On the basis of Mr. Schwittek's testimony we find that he was referring not to the capability of the equipment to function utilizing the inventions which are the subject of this appeal, but rather to his lack of information as to what funds might be made available to perform additional engineering work, including the preparation of drawings, on the basis of which SC900A type equipment could be manufactured in production quantities (Tr. 1-116-118).

In the introduction to its 12 May 1959 proposal (Rule 4, Tab 36), referred to above, appellant stated that:

"At the present time, there are fifteen highly qualified engineers working on this program, and it is expected that the final model of the Stromberg-Carlson single sideband transceiver will be completed and ready for extensive testing by July of this year."

Mr. Schwittek testified that prediction of readiness of the equipment by July was probably indicated with a view to customer inspection of the equipment at a time when the SC900A could be thoroughly demonstrated. Appellant's engineers desired the maximum amount of lead time available to assure satisfactory operation of the system as a whole (Tr. 1-105-106). As indicated above, the proposal was prepared prior to the work performed on individual modules and the system as a whole during May and early June 1959. There is no evidence that the estimated July readiness date for the SC900A was based specifically on the

extent to which the inventions involved in this appeal were shown to be workable at the time the proposal was prepared.

During late June 1959 appellant continued to make improvements and corrections in various aspects of the SC900A circuitry. Mr. Harrison testified that efforts continued to be made to find the best way of switching digital tuning elements mechanically. Such work was carried forward as part of appellant's performance under the WRC-1 contract in order to develop a unit which would have the required characteristics and yet be susceptible to mass-production without the involvement of talented engineers in the production (Tr. 3-18-19).

Work also continued on certain elements of the SC900A power amplifier. Between 15 June and 10 July 1959 testing was conducted on coils designed to accommodate frequencies over which tests had not previously been performed. Appellant was then developing a procedure for designing coils and desired to assure itself that the design was adequate for all required frequencies. Tests were conducted in order to verify that coils designed in accordance with the procedure would operate in the power amplifier (Tr. 3-98-102). Appellant also waterproofed the two megacycle coil with a view to assuring that the equipment would function in humid atmospheres. Mr. Dagleish testified that the waterproofing process usually changes some of the characteristics of a coil, but that it did not affect the negative feedback over the capacitor bridge circuit or otherwise affect the inventive concept embodied in the power amplifier (Tr. 3-101).

During July appellant also first tested an antenna coupling unit, the device which went between the antenna and the power amplifier. The absence of an antenna coupling unit did not prevent the SC900A from operating if the antenna were suitably designed (Tr. 3-109). There is no evidence that the lack of an antenna coupling unit affected the operability of the power amplifier during the tests conducted in May and June.

Work under NObsr-77628, the WRC-1 contract, commenced on or about 1 July 1959 (Tr. 2-136). The SC900A project, in existence since the fall of 1958, was terminated as an independently-funded corporate endeavor. Many of the engineers who worked under that project, including Messrs. Schwittek, Harrison, Dagleish, Clark and Van Sandwyk, became involved in the development effort under the contract. In effect the SC900A was a fore-runner of the WRC-1 (Tr. 1-90), and there was no drastic change in the types of engineering tasks being performed as of 1 July 1959 (Tr. 2-134). Individual SC900A modules were tested to determine their usefulness in the effort to meet the contract specifications (Tr. 3-65), and were

used for interfacing with WRC-1 modules and conducting comparability tests during the course of performance under the contract (Tr. 4-36-37, 86-87).

Work under the WRC-1 contract involved modules embodying the inventions at issue in this appeal (Tr. 2-142). Under the contract appellant was required to file development status reports, the first of which, covering the July through September 1959 period, was received in evidence as Exhibit A-16. The report indicates that appellant was performing studies in connection with the frequency synthesizers and translator, and was conducting experiments in order to determine the selection of tubes to be used in the power amplifier. From the report we find that during the first three months of work under the contract appellant was performing design and testing of experimental WRC-1 modules which included the digital tuning and power amplifier inventions involved in this appeal. However, the description of the work actually performed is highly technical in nature and no probative evidence has been presented which might explain whether this work indicated that the practicality of those inventions had not yet been established, or whether the work consisted merely of refinements or alternative implementations of inventions already shown to be workable.

The contract also required the submission to the Government of data taken from the notebooks of appellant's engineers who were working on the WRC-1 development. Actual notebook pages, reproduced in microfilm form, were submitted to the Government and later examined by Mr. Warfield as a part of the investigation referred to above. Some of the notebook pages examined by Mr. Warfield were received in evidence as Exhibits R-1 through R-4. This evidence indicates that after 1 July 1959 appellant's engineers continued to design and test digital tuning circuits and power amplifier coils, among other things. However, again no probative evidence has been presented which might establish the relationship between the data set forth on these notebook pages and the workability of any of the inventions involved in this appeal.

The WRC-1 contract called for a transceiver similar to the SC900A. According to Mr. Harrison, however, there were vast differences in the specific requirements for employing the techniques that were utilized in the SC900A (Tr. 2-141-142). Considerable redesign of circuitry and components was necessary in order to satisfy particular Navy configuration and dimensional requirements (Tr. 2-138, 143). Circuitry was redesigned in order to provide for use of a new, advanced type of transistor (Tr. 2-139). The WRC-1 was considerably more

complex in that it included a capability of receiving signals on both the upper and lower sideband at the same time (Tr. 2-141). Much of the engineering work performed after award related to the development of equipment which would satisfy the vibration, temperature, and other environmental requirements imposed under the contract. Other engineering work related to arriving at a design and component selection suitable for production of transceivers in quantity (Tr. 1-90, 150-156, 3-19). On the basis of the evidence presented, we find that much of the work performed under the WRC-1 contract involved changes in the implementation of the inventive concepts embraced by the patents involved in this appeal, but the concepts themselves were not changed.

The award of NObsr-77628 did not put an end to appellant's independent work on single sideband transceivers. Appellant continued to investigate techniques in the single sideband area using corporate funds not related to the WRC-1 development effort. After the initial engineering designs under the WRC-1 contract were completed, some of the engineers who performed that effort were transferred to a company-sponsored program encompassing the development of production model single sideband transceivers for sale as inventory items to the Air Force (Tr. 1-183-184). Between 1961 and 1963 appellant was producing an SC900 series of single sideband equipment for

sale both commercially and to the Government as off-the-shelf items described in sales brochures and catalogs. Each of the items included in this series of equipment incorporated devices covered by some or all of the patents involved in this appeal (Tr. 2-146-149; Exh. A-17, A-18).

At the time NObsr-77628 was awarded, appellant's patent department endeavored to collect all information pertaining to the SC900A development which had been reduced to drawings and sketches, and the actual hardware that had been constructed (Tr. 3-10-11). As of that time no formal disclosures of the inventions involved in this appeal had been made by appellant's engineers to the patent department.

Under appellant's standard instructions to employees relating to patent policies and procedures, information concerning inventions was to be furnished to the Patent Department on a prescribed form called an "Inventor's Draft." According to appellant's instructions,

"The Inventor's Draft should be filled out and forwarded as soon as the invention has progressed to the point where it is deemed to have utility. It is not necessary to build and test a sample before preparing and submitting the Draft." (Rule 4, Tab 20)

With respect to the inventions involved in this appeal, inventor's draft forms were filled out on the following dates (Rule 4, Tabs 25-29):

<u>Invention</u>	<u>Date</u>
Phase Locked Oscillator	19 August 1959
Digital Tuner	29 September 1959
Automatic Gain Control	24 August 1959
Frequency Changer	24 September 1959
Power Amplifier	6 October 1959

After the inventor's drafts were received by appellant's patent department, each invention was assigned a docket number and the inventor who submitted the inventor's draft was asked to fill out a questionnaire. One of the questions asked was:

"Was this invention conceived or first actually reduced to practice during experimental, developmental or research work under a Government contract?"

The question was answered in the negative as to each of the five inventions involved in this appeal (Rule 4, Tabs 25-29; Exh. A-22). Although these questionnaires were not dated, there is no evidence indicating that they were

not filled out shortly after the inventor's drafts were prepared.

Patent applications were filed and the patents were issued as indicated in the table on page 7 of this opinion.

The record in this appeal includes affidavits signed by several of the engineers who were involved in the SC900A project or with single sideband equipment produced afterwards. These affidavits were among the materials submitted to the Government under appellant's letter dated 13 February 1968 (Rule 4, Tab 9). Some of these affidavits were prepared in 1966, after the dispute arose. However, the affidavits executed by Mr. Harrison, Mr. Schwittek and Mr. Bettin were all dated 23 September 1960, a

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date prior to completion of the contract, and almost four years prior to the time the Government first indicated to appellant that the Government was considering its entitlement to licenses to practice the five inventions involved in this appeal. These affidavits were prepared by appellant's Patent Department for signature by those engineers, apparently for the purpose of supporting the patent applications previously filed (Tr. 3-167). These affidavits corroborate the testimony of appellant's witnesses presented at the hearing in that the affidavits collectively indicate that the SC900A and other equipment constructed and tested on or before June 1959 embodied the inventions described in the patent applications, and that SC900A was operative when tested in May and early June 1959.

### Decision

The sole issue for decision is whether any or all of the five inventions involved in this dispute were reduced to practice prior to the time appellant commenced work under NObsr-77628, which was on or about 1 July 1959. The parties are initially in dispute over which side has the overall burden of proof. Appellant says that since the Government is claiming licenses to practice these inventions, the Government has the burden of establishing that the reductions to practice took place after performance under the contract commenced. The Government, on the other hand, contends that appellant has the burden of establishing that the reductions to practice occurred prior to the outset of performance.

In disposing of this question we consider persuasive the opinion of the Court of Customs and Patent Appeals in *Williams et al. v. Administrator of the National Aeronautics and Space Administration (NASA)*, 463 F.2d 1391 (C.C.P.A., 1972). In that case the Government was claiming title to an invention on the ground that it had been reduced to practice in the course of the contractor's performance of a NASA contract. Although that case involved 42 U.S.C. § 2457, which vested title to such patents in the United States, and not the Patent Rights clause, the issues relating to reduction to practice were very similar to the issues raised in this appeal. In *Williams*, the Court resorted to basic tenets of the law of evidence. It held that the general burden of persuasion was on the Government to establish the validity of its allegation that the inventions were reduced to practice under the contract. However, it further held (at p. 1401) that:

"This case was concerned with what happened prior to and *outside* of the contract—events occurring *under* the control of the inventor, the facts surrounding which *he* is in a

position to know and NASA is *not* in a position to know. We feel that acts such as those shown here, should be treated as affirmative defenses, and the burden of proof must be placed on the inventor." (Emphasis supplied by the Court)

We consider this division of the burden of proof applicable to the resolution of the present dispute.

In the absence of any evidence as to events which transpired prior to the award of NObsr-77628, the Government would prevail on the basis of the evidence establishing that work involving the patented inventions was performed under the contract, and the dates on which the inventor's drafts were prepared. However, the *Patent Rights* clause speaks in terms of *actual* conception and reduction to practice. The dates on which the inventor's drafts were prepared are relevant to the question of when the inventions were reduced to practice, but they are not conclusive. Judicial authorities do not support the proposition that an actual reduction to practice is dependent upon such formalities as the preparation of inventor's drafts or the filing of patent applications. See *Eastern Rotorcraft Corporation v. United States* [12 CCF ¶81,394], 181 Ct. Cl. 299, 384 F.2d 429 (1967). Moreover, as our findings of fact indicate, a considerable amount of evidence has been presented concerning the design and testing of modules embodying the patented inventions prior to the award of the contract. Whether or not that work satisfied the standards for reduction to practice is the dispositive question.

In the Government's view, appellant's burden of proof is very heavy. The Government cites numerous cases beginning with *Coffin v. Ogden*, 18 Wallace 120 (1873) as standing for the proposition that every reasonable doubt should be resolved against the party who has the burden. The cases relied upon by the Government involved patent interferences; that is, whether a patent application filed later should prevail over a patent application filed earlier with respect to the same invention. Such cases involve a determination of which party should be entitled to the monopoly conferred by the patent statutes. However, in disputes arising under the Patent Rights clause of a Government contract there is no dispute over title to the patent, which remains in the contractor. We are not persuaded that the burden imposed upon appellant in seeking to establish its alleged reduction to practice should be greater than a preponderance of the evidence, the usual burden which prevails in disputes arising under Government contracts.

In connection with its contention that appellant has a very heavy burden of proof, the Government maintains that the Board should apply certain rules which would seriously



detract from the weight to be accorded the evidence presented by appellant. The Government relies on *Tidewater Patent Development Co. v. Gillette Company*, 273 F.2d 936 (4th Cir., 1960), and other cases as standing for:

"...the established rule that an inventor's own testimony with respect to his invention and reduction to practice constitutes a self-serving declaration and cannot be given probative force even if it is uncontradicted and convincing unless it is supported by adequate corroboration." (273 F.2d at 940)

The Government further maintains that the inventor's notebooks are also self-serving and not sufficient of themselves to establish corroboration. Several cases are again cited, including *Thurston v. Wulff*, 164 F.2d 612 (C.C.P.A., 1947). Examination of the authorities relied upon by the Government indicates that they again involved patent interference proceedings, which we consider distinguishable with respect to burden of proof and other evidentiary questions. Moreover, in resolving disputes arising under Government contracts we are not inclined to apply rules which would mechanically determine the evidentiary weight to be assigned categories of evidence independent of the probative value such evidence might have when considered in the context of the record as a whole. In *Ritter v. Rohm & Haas Co.*, 271 F. Supp. 313 (S.D.N.Y. 1967), a patent infringement suit, the Court stated:

"We are disinclined to rely on quantitative rules of evidence in our search for truth. Their appeal of simplicity is outweighed by the vice of blindness. Rather, we look to the purpose behind the rule requiring corroboration for guidance in its application. The manifest purpose of the rule is to prevent fraud. When the validity of a patent turns on the exact date a certain event occurred, or discovery was made, there is an inherent risk of perjury if after-the-fact oral testimony by the most interested party, the alleged inventor, can carry the invention date back beyond the filing date."

In the appeal before us there is no basis to doubt the credibility of the witnesses who testified on appellant's behalf. The named inventors on the five patents had assigned their interests to appellant by operation of their respective employment agreements. Furthermore, it is clear from the record that appellant's principal witness, Mr. Harrison, and most of appellant's other witnesses were not employed by appellant at the time they presented their testimony at the hearing in this appeal. Although the recollections of witnesses differed in minor measure as to the timing of certain events, this is more likely attributable to the thirteen-year lapse of time between those

events and the hearing in this appeal than to any bias on the part of the witnesses. We have previously discussed the evidentiary value of the engineers' notebooks presented as exhibits, and have found that the data contained therein is not to be considered unreliable for lack of strict compliance with the instructions for maintenance of the notebooks. We accordingly conclude that the weight accorded the evidence presented by appellant is not subject to reduction on the basis of rules of corroboration customarily employed in patent-interference cases.

Both parties have cited in their respective briefs many judicial opinions, and some decisions of Boards of Contract Appeals, setting forth in general terms what facts or events amount to a reduction to practice. The authorities appear to be in agreement that reduction to practice occurs when the workability of an invention can be demonstrated in some physical form. In other words, the capability of the invention to function as intended must be established through the operation of some physical mechanism. See, e.g., *Eastern Rotorcraft Corporation v. United States*, *supra*. The difficult question is determining the quantity and quality of operations or testing necessary in order to establish workability. On this matter the authorities frequently recite the following quotation from *Robinson on Patents* (1890), § 127:

"Moreover the law demands, for the completion of the inventive act, that the art shall be so practiced or the article of manufacture so tested, that its efficacy and utility are fully demonstrated. 'Reduction to practice' means 'reduction to successful practice.' Experiments in the direction of the desired result are not such reduction, no matter how nearly they approximate that end. The work of the inventor must be finished, physically as well as mentally."

See *Elmore v. Schmitt*, 278 F.2d 510 (C.C.P.A., 1960); *Bell Aerosystems Company, Division of Bell Aerospace Corporation*, ASBCA No. 9005, 67-1 BCA ¶ 6203.

Whether particular tests fully demonstrate the efficacy and utility of an invention, or whether the tests establish the capability of the invention to function successfully, are questions of fact to be determined upon the evidence presented. In this connection we find persuasive Judge Learned Hand's opinion in *Sinko Tool & Manufacturing Co. v. Automatic Devices Corp.*, 157 F.2d 974 (2d Cir., 1946) in which he stated (at p. 977) that:

"The doctrine to be drawn from the books, as we read them, is this—and incidentally it is the only doctrine that can find support in reason: a test under service conditions is necessary in those cases, and in those only, in which persons

qualified in the art would require such a test before they were willing to manufacture the invention as it stands."

Similar views were expressed by the Court of Claims in *Eastern Rotorcraft Corporation v. United States*, *supra*, and by the Court of Customs and Patent Appeals in *Williams et al. v. NASA*, *supra*. This view places principal emphasis on the opinions of persons qualified in the art in determining the level of testing needed to establish workability. The rule is that the testing must establish that the invention would work as intended in its contemplated use. *Elmore v. Schmitt*, *supra*. But depending upon the nature of the invention and the actual quantity and quality of testing conducted, laboratory tests, as distinguished from actual service tests may be sufficient to establish workability. *Pavinen v. Sands*, 339 F.2d 217 (C.C.P.A., 1964). And it is not necessary that the testing prove the invention flawless; it is only necessary to establish that the invention is capable of performing its intended function beyond a probability of failure. *Eastern Rotorcraft Corporation v. United States*, *supra*.

As found above, the inventions involved in this appeal were electronic concepts, schemes or techniques not tied to specific components or circuitry configurations. With respect to all of these inventions appellant's witnesses, who were skilled in single sideband electronics, were of the opinion that the module testing conducted in appellant's laboratory on dates prior to the award of NObsr-77628 established the capability of the inventions to function as intended. That opinion is supported by many of the facts which we have found above. The Government argues the testing performed on only a few representative frequencies was insufficient to demonstrate workability. However, the Government presented no probative evidence contradicting the views held by appellant's witnesses that further quantitative testing of the modules embodying the inventions was insignificant for the purpose of establishing that the inventions, reduced to physical form, would function as intended. The fact that the SC900A did play as a system is further evidence that the inventions had utility in at least one practical application. On the record presented we conclude that the testing performed by appellant prior to award of the contract was of a level sufficient to establish the workability of the inventions. We further find that the workability of the frequency changer invention had previously been established through its use in highway flashers.

The Government's case is rested in large part on its argument that the -057 patent affected all of the patents. Thus, in the Government's view, if the -057 invention was not

reduced to practice, none of the other inventions were reduced to practice. It is clear that the digital tuning invention bore certain relationships to the other four inventions involved in this appeal, as those inventions were employed in the SC900A radio. However, no probative evidence has been presented establishing that the workability of the AGC invention, the power amplifier invention, the frequency changer invention, and the phase-locked oscillator invention, depended upon the workability of the digital tuning scheme embraced in the -057 patent. These inventions had utility for purposes other than single sideband radios. The dependency which the Government would have us find is of a kind which, to be established, must be based on expert testimony or other equally probative evidence. For lack of proof we are unable to find that the status of the digital tuning invention controlled the status of the other four inventions.

The Government further argues that the inventions were not reduced to practice on the ground that the testing conducted prior to award of the contract did not indicate that the inventions were capable of being used in a rugged, military environment. We agree that the testing did not so indicate, but this fact is irrelevant to the question of whether the inventions were reduced to practice by mid-June 1959. There is no evidence establishing that the utility of the inventions was dependent upon their employment in military devices. Our findings are to the contrary. Nothing in the patents themselves indicated that the inventions were limited to use in military equipment. We are unable to conclude that reduction to practice of these inventions depended upon the satisfactory completion of environmental tests of a sort contemplated by the specifications included in NObsr-77628.

The Government further contends that appellant failed to establish a connection between the work performed prior to award of the contract and the patented inventions as defined by the claims stated in the patents. The claims of the patents are the numbered paragraphs in a patent specification:

"particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention." (35 U.S.C. §112)

The Government maintains in effect that since the requisite connections were not established, appellant has failed to prove that all aspects of its inventions as defined by the claims were reduced to practice prior to award of the contract.

We agree with the Government that the definitions of the inventions as recited in the claims may not be disregarded in determining whether the evidence establishes an actual re-

duction to practice. *Smith v. Stone*, 420 F.2d 1065 (C.C.P.A., 1970). In our opinion, however, the evidence presented by appellant has established, *prima facie*, that the various implementations of the inventive concepts prior to award involved all aspects of the inventions as defined in the patent claims. The claims are stated in technical language. Even if they are to be considered clear and unambiguous, other parts of the patent instrument and materials not included in the patent itself may be used to gain an understanding of precisely what is claimed by the inventions. *Autogiro Company of America v. United States*, 384 F.2d 391 (Ct. Cl., 1967). Our findings indicate numerous examples of identities or close similarities between circuitry configurations developed by appellant prior to award of the contract, and circuitry configurations depicted on figures made part of the patents. On this state of the record it was incumbent on the Government to explain, through probative evidence, how particular claims in the patents were not satisfied, from the standpoint of reduction to practice, by the work performed by appellant prior to award. Such an explanation is not contained in the record before us.

In this regard we do not overlook the Government's argument that the digital tuning circuitry developed by appellant was not tunable in one kc increments. The digital tuning module installed in the SC900A at the time of the system testing in late May and early June 1959 was not tunable in one kc increments since the knob was fixed. However, as found above, the capability of the one kc synthesizer to tune in one kc increments was demonstrated by breadboard testing on or about 25 February 1959. We have further found that the absence of a one kc tuning capability in the system tested in May and June 1959 did not indicate that the digital tuning scheme as defined in the -057 patent was incapable of providing for tuning in one kc increments. Furthermore, we have examined the nine claims stated in the -057 patent and are unable to find a specific requirement for tuning in one kc increments. On the record presented we conclude that the absence of a one kc tuning capability in the SC900A, as tested in late May and early June 1959, did not affect the status of the digital tuning invention which was otherwise shown to be workable prior to award of the contract.

We have also evaluated the evidence relating to the work which appellant intended to perform, and actually did perform under NObsr-77628 with a view to determining whether work performed under the contract demonstrated for the first time the workability of the inventions. The Government emphasizes

those aspects of appellant's proposal which indicate that much development work on single sideband equipment was yet to be accomplished. However, as found above, the proposal also indicates much of the work which appellant had accomplished at the time it was written. Typical of most proposals for development contracts, appellant's proposal was an attempt to demonstrate how its established capabilities would be used to achieve the goals set forth in the contract specifications. As found above, the proposal does indicate that successful operation of modules embodying some of the patented inventions had been achieved by the time the proposal was submitted. We are unable to find that the proposal indicated that some or all of the five inventions involved in this appeal were not yet found to be workable, as distinguished from indications that much work remained to be performed before a single sideband radio embodying the inventions would meet the military requirements set forth in the request for proposals. The evidence also fails to establish that appellant's agreement to share in the costs of performance under the contract indicated that the utility of the inventions had not yet been demonstrated.

As indicated by our findings, work performed by appellant after award of the contract involved the patented inventions, particularly the digital tuning scheme and the power amplifier. However, in view of the evidence presented, as detailed in our findings, we are not persuaded that such work amounted to further efforts to establish the workability of the inventions, as distinguished from efforts to refine or develop alternative implementations of the inventions with a view to mass-production of single sideband radios or satisfying requirements peculiar to the military specifications. We are likewise not persuaded that the difference between the estimated cost of the contract as awarded and the total amount finally made available represents, in whole or in part, efforts to establish the workability of the five inventions involved in this appeal.

In connection with the power amplifier invention we have considered the work on coils performed during July 1959. However, on the basis of our findings we conclude that this work did not relate to establishing the workability of the invention. We have also considered the differences between diagrams in the AGC patent and similar diagrams included in appellant's proposal. We similarly conclude, on the basis of our findings, that these differences are immaterial to establishing the workability of the invention.

In *Williams et al. v. NASA*, *supra*, the Court was influenced in substantial measure by the willingness of the Government to spend

millions of dollars to develop a communications satellite in reliance upon tests cited by the appellant in that case as the basis for its contention that the invention at issue had been reduced to practice prior to the award of the contract. In the record before us there is evidence that Government representatives, prior to the award of NObsr-77628, were impressed with appellant's inventions in the area of single sideband communications. The award of NObsr-77628 on the basis of appellant's proposal, containing test data referred to in our findings, indicates that the Government was willing to spend considerable sums for the performance of development work involving inventions over which the present dispute has arisen. The inventions involved in this appeal were basic to appellant's innovative approach to single sideband communications. As our findings indicate, appellant believed, at the outset of the SC900A program, that it would have to demonstrate a capability of making significant improvements over existing single sideband equipment in order to obtain military development contracts. In our opinion, the award of NObsr-77628 to appellant is a further indication that this capability, including the workability of the five inventions involved in this appeal, had been demonstrated by mid-June 1959.

On the basis of the foregoing, we conclude that the five inventions involved in this appeal were reduced to practice prior to the commencement of performance under NObsr-77628, and that the Government is not entitled to the licenses which it claims under the Patent Rights clause of the contract. The appeal is accordingly sustained.

#### [19961] CRANE COMPANY

ASBCA No. 16999. March 14, 1973. Contract No. DSA 700-70-C-8540.

#### Defaults—Excuses—Government Priority

A contractor's failure to meet delivery schedules was not excusable under the Defaults clause of his contract because the delay was due to his own negligence and not to the operation of the government Defense Priority System. Prior to the time the contractor entered into the subject contract, he had other orders which, by virtue of the priority system, he was to perform first. Consequently, he knew or should have known that the existing orders would preclude meeting his delivery commitments.

Patton, Boggs, Blow, Verrill, Brand & May  
by Harry A. Inman, John H. Vogel, and Paul R.

Contract Appeals Decisions

Hundt, of counsel, for the appellant. James C. Hubbard and Cyrus E. Phillips IV for the government.

Opinion by Mr. Lussier with Mr. Hundt, Mr. Cohen, Mr. Solibakke, and Mr. Andrews, Jr., concurring.

This case presents the single issue of whether Crane Company, the appellant, herein, has established that its failure to deliver supplies under the subject contract was due to a cause which is excusable under the "Default" clause of the contract. If so, the termination for default which was issued against this contract will be converted to a termination for the convenience of the Government by virtue of subparagraph (e) of the "Default" clause.

To be found "excusable" the cause of the default must meet the test set forth in subparagraph (c) of the "Default" clause which provides:

"(c) Except with respect to defaults of subcontractors, the Contractor shall not be liable for any excess costs if the failure to perform the contract arises out of causes beyond the control and without the fault or negligence of the Contractor. Such causes may include, but are not restricted to, acts of God or of the public enemy, acts of the Government in either its sovereign or contractual capacity, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and unusually severe weather; but in every case the failure to perform must be beyond the control and without the fault or negligence of the Contractor. If the failure to perform is caused by the default of a subcontractor, and if such default arises out of causes beyond the control of both the Contractor and subcontractor, and without the fault or negligence of either of them, the Contractor shall not be liable for any excess costs for failure to perform, unless the supplies or services to be furnished by the subcontractor were obtainable from other sources in sufficient time to permit the Contractor to meet the required delivery schedule."

#### Findings of Fact

The subject contract was awarded to Crane Company on December 9, 1969 by the Defense Construction Supply Center, Columbus, Ohio. As amended, the contract called for delivery of twenty-one 5½ inch 400 lb. cast steel toggle-operated globe valves for a total contract price of \$123,018.00. The contract was negotiated with Crane inasmuch as Crane apparently was the only company having the "pattern" equipment to make the needed castings for the valve bodies and components (Tr. 1-15). These particular valves were intended for use on the