[Protest of Anticipated Rejection of Proposal]

DECISION

**THE COMPTROLLER GENERAL
OF THE UNITED STATES**
WASHINGTON, D.C. 20548

FILE: B-195053

DATE: April 7, 1980

MATTER OF: Memorex Corporation

DIGEST:

Specification requiring disk drive inter-
changeability at "device level" which was
included due to faulty mathematical analysis
is not rationally founded and is unduly
restrictive of competition. Properly calcu-
lated, underlying 98 percent system avail-
ability rate requirement is met without
interchangeability requirement, e.g. if only
single plug-to-plug compatible string of
drives is added.

Memorex Corporation protests the anticipated rejec-
tion by the Department of the Army of Memorex's proposal
to furnish plug-to-plug compatible disk storage equip-
ment (memory) being procured under RFP DAHC26-79-R-0010.
The contractor will furnish one additional disk "string"
consisting of one TELEX 6833-11 disk controller and 8
TELEX 6316-11 disk drives, or equal, for use by the
Pentagon Consolidated Telecommunications Center. Memorex
is unable to amend its proposal to conform to that portion
of Amendment 2 (issued after the closing date for receipt
of initial proposals) which states that the equipment
offered must have what the Army calls "interchangeability
at the device level." The Army has indicated its intention
to reject Memorex's proposal if this protest is denied.

By device level interchangeability, the Army means
the string being purchased must be not only electroni-
cally compatible with existing equipment and be able
to accept existing disk packs but must permit it to
physically interchange new with existing disk drives,
achieving a reconfiguration "on a single device or several
device basis, onto the existing disk subsystems without
* * * modifications or degradation." Commonly available

plug-to-plug compatible disk drive systems, including
strings manufactured by Memorex, are electronically com-
patible with other industry standard equipment, including
the equipment now in use at the Pentagon. Such equipment
will accept standard disk packs, i.e. the media on which
data is recorded, allowing individual disk packs to be
moved between Memorex and existing equipment, as needed.
In Memorex's view, the Army's further requirement,
demanding compatibility between system components
(controllers and drives) installed in separate strings,
limits participation to equipment manufactured by the
brand name product manufacturer and is inconsistent with
industry practice and unwarranted.

Arguing that the Government's requirements may be
unique in this instance, the Army states that its purpose
in issuing Amendment 2 is to assure that it will achieve
a 97.4 percent availability rate (essentially, 98 percent,
it says) which it believes is a cost effective and accept-
able performance figure. A system availability rate, as
that term is used here, may be defined as the probability
expressed as a percent that the system functions at least
at a minimum acceptable performance level. The existing
Pentagon system includes six strings, each consisting of
one controller wired to eight disk drives. In addition
to adding a seventh eight drive string, the Army intends
to wire the existing strings to take advantage of the
capability of each controller to handle up to 16 drives,
i.e. two strings. Moreover, the system can be operated
at a minimum acceptable level if any 35 disk drives are
usable. Assuming that each device (controller or drive)
has a 90 percent chance of being available, the Army cal-
culates that the 97.4 percent figure is only achieved if
each device in the seventh string can be physically relo-
cated should that prove necessary, allowing that device
to be used to replace a malfunctioning unit in an existing
string.

The Pentagon Consolidated Telecommunications Center
is a critical defense facility. We agree with the Army
that the highest theoretical availability rate is achieved
if device level interchangeability is required. Were this
simply a matter, then, of achieving the highest possible

theoretical performance to meet valid Army needs, we would deny Memorex's protest. On-Line Systems, Inc., B-193126, March 28, 1979, 79-1 CPD 208.

Instead, however, the Army bases its need entirely on a mathematical analysis showing, it says, that an acceptable system availability rate (97.4 percent) can be achieved only with device level interchangeability. A solicitation provision which limits potential offerors' freedom to proposal products they believe are suitable is an undue restriction on competition unless the contracting activity can establish a prima facie basis for the requirement. Constantine N. Polites & Co., B-189214, December 27, 1978, 78-2 CPD 437. While justification of the Army's need depends in part on whether the assumptions on which its analysis was based are reasonable, its requirement is not rationally supported where the analysis on which it is based, i.e., the mathematics, is performed incorrectly.

The necessary mathematical analysis is outlined below. The mathematics is complex. However, the Army's analysis appears seriously flawed, because the Army did not take into account all of the calculations contributing to total system availability. Properly completed, the mathematics indicates that the Army's 97.4 percent figure is met simply by adding one Memorex string. The denigration of system performance which would result by not requiring device level interchangeability evidently is much less than the Army expects--a difference amounting only to 0.00156 percent. Allowing noninterchangeability in the seventh string has at best only an insignificant (third order) effect when compared with the increase in availability which could be achieved by enhancing device level performance, per se, or which will be achieved by wiring the existing controllers in pairs.

Regardless of whether similar or dissimilar drives are utilized, the system availability rate is 100 times the sum of the separate probabilities that each possible combination of drives and controllers allowing at least 35 operable drives to be accessed will occur. Assuming as the Army has that the probability of any one device operating is independent of whether any other device operates, the probability of each combination of working drives and controllers occurring is the product of the

probability that the required number drives will work
times the probability that the requisite number of con-
trollers work.

The Army correctly recognizes that the probability
of selecting any given number of operating devices from
a larger set is a binomial distribution. If the con-
trollers are not wired in pairs, the availability rate
of a 7 string fully interchangeable system is 100 times
the product of the probability that at least five con-
trollers work (0.9743085) times the probability that
at least 35 of the 56 drives are operating (0.9999999).
This produces an availability rate of 97.43084 percent,
using as we have computer generated tables to calculate
the binomial values required.

Also, the Army recognizes that a system using one
Memorex string with the six existing fully interchangeable
strings must have a higher availability rate than the
existing six interchangeable string system (88.55776
percent). However, the availability rate obtained by adding
a Memorex string to the existing system also must be greater
than 100 times the probability that at least 35 out of 48
drives operate (0.9998223) times the difference between
the probability that at least five of seven controllers
work (0.9743085) and the product of the probabilities that
the Memorex controller works (0.9 exactly) and that two
or less Memorex drives operate (0.00002341). That is, it
cannot be less than 97.41143 percent.

This is because the probability that at least 35 out
of the original 48 drives work is always less than the
probability that at least some number of drives less
than 35 operate and because the probability of an event
occurring is defined mathematically to be greater than or
equal to zero and less than or equal to one. Considering
each possible combination of working (or non-working)
Memorex equipment separately, and computing how much
additional, i.e., existing equipment must work, the
availability rate can be expressed as the sum of several
terms each having as a multiplier the probability that
at least 35 (or less) of 48 existing drives operate.
Consequently, the availability rate must be greater than
the result computed if the probability that at least
35 of 48 drives operate is substituted. Factoring this
common multiplier, the remaining expression differs from

the probability that five out of seven controllers work
by only three terms, viz: the terms related to computing
the probability that the Memorex controller works but
that only 0, 1, or 2 Memorex drives operate. The lower
bound is preserved by simply ignoring the contribution
of these three terms, completing the expression for the
probability that five of seven controllers operate, and
subtracting and simplifying an offsetting quantity.

The result computed (97.41143 percent) must be less
than the availability rate which would be experienced
were a non-interchangeable (Memorex) string added to
the existing system, which in turn must be less than
the availability rate which would be achieved were device
level interchangeability required (97.43084 percent,
computed earlier). As those figures indicate, not requiring
seventh string device level interchangeability at best has
only a limited effect. Moreover, this analysis demonstrates
Memorex's belief that the increase in availability rate
achieved by adding the seventh string results primarily
from the addition of a seventh controller, because: (1)
the total number of drives is large compared with the
number required and (2) the probability that only two or
fewer Memorex drives would be operable is quite small.

Plainly, the Army's belief expressed in a report to
our Office that "[o]nly use of interchangeable equipment
on the 7th string will result in a real increase in system
availability" is mistaken. The availability rate increases
from approximately 88.6 percent to at least 97.4 percent
by simply adding a Memorex string.

Although, as we have stated, the availability rate
for the system must be computed by adding the probabili-
ties that all operable combinations of devices will work,
the Army only calculated some of the probabilities for
individual possible working combinations. To illustrate,
the Army, considering only "worst cases", argues that the
availability rate of a seven string system with paired
controllers drops to 93.5 percent if interchangeability
is not permitted. The availability rate of such a system,
however, cannot be less than that for a system without
paired controllers. It cannot be less either than the
availability rate computed for a six string paired system,
with or without interchangeability. A six string paired
system is a rather special case, in this regard, because

the system availability rate is the same whether there is
interchangeability or not. This is due to the inability
of only two pairs of strings to provide 35 drives. All
three sets must have at least one operating controller,
resulting in a computed system availability rate of 96.93
percent. In effect, by failing to perform a complete analy-
sis, the Army led itself to believe that a significant
difference in performance exists when in fact the deteri-
oration of performance it calculates almost entirely
reflects the contribution of those elements of the answer
which it did not compute.

To assure accuracy, we have calculated exact avail-
ability rates, again using computer generated tables.
Without repeating our analysis in detail, we calculate
the availability rate of the existing system plus one
Memorex string (a total of seven strings, eight drives
per string, without pairing controllers but with 6
strings interchangeable at the device level) to be
97.4292794128 percent to ten places.

Subtracting this figure from that calculated earlier
assuming device level interchangeability indicates that
adding interchangeability at the device level for string
seven would contribute only an additional 0.00156 percent
to the availability rate which is achieved by merely add-
ing a Memorex string.

Also, we have computed other related availability
rates, as follows:

1) The availability rate which results if existing
controllers are merely wired in pairs (3 pairs
of strings of 8 drives) as the Army plans is
97.012661 percent.

2) Adding a Memorex string to the existing system
(if that system is wired in pairs) raises its
availability rate to 99.674787 percent.

Moreover, although the Army assumed a device level
availability rate of 90 percent, we understand that a 95
percent device level availability rate is the accepted
industry standard for equipment of this type. At least
newer equipment can be expected to attain availability
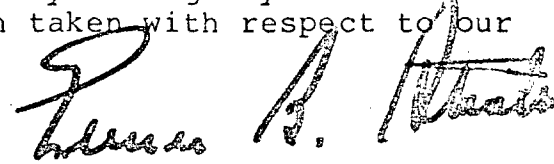rates of 98 percent. To establish a basis with which

to compare the relative importance of device level interchangeability, therefore, we computed the effect which a one percent increase in the probability that a device is operable (from 90 percent to 91 percent) would have. The availability rate computed for the existing system plus Memorex string is increased from approximately 97.429 percent to 98.067 percent. Clearly, differences in device availability have a much greater impact than assuring device level interchangeability.

In the circumstances, the Army's requirement for device level interchangeability has not been rationally supported. The Army's 97.4 percent criteria is met by adding a Memorex string. It is nearly met by simply wiring the existing controllers in pairs. If the existing controllers are paired, the addition of a Memorex string results in a system which far exceeds the Army's criteria. Moreover, the difference in the availability rates which results by adding an interchangeable rather than a noninterchangeable seventh string appears wholly inconsequential.

The protest is sustained.

By separate letter we are today bringing our decision to the attention of the Secretary of the Army. We are also bringing to his attention our recommendation that the Army reconsider its need for amendment 2 in light of our decision. If the necessity for device level interchangeability cannot be supported otherwise, it should be deleted and discussions reopened, permitting equal consideration of Memorex's proposal.

This decision contains a recommendation for corrective action to be taken. Therefore, we are furnishing copies to the Senate Committees on Governmental Affairs and Appropriations and the House Committees on Government Operations and Appropriations in accordance with section 236 of the Legislative Reorganization Act of 1970, 31 U.S.C. § 1176 (1976), which requires the submission of written statements by the agency to the Committees concerning the action taken with respect to our recommendation.

Comptroller General
of the United States