



WATERFORD 3 SES
PLANT OPERATING MANUAL
LOUISIANA
POWER & LIGHT

POM VOLUME 9
POM SECTION 6

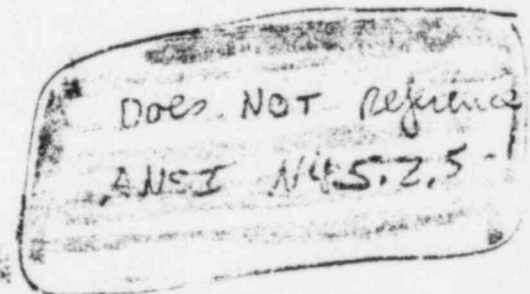
MM-6-012
REVISION 0
APPROVAL DATE: May 26, 1982
EFFECTIVE DATE:

MAINTENANCE PROCEDURE
STRUCTURAL BOLT TENSIONING

SKIDMORE WILHELM
TORQUE TEST INSTRUCTION
MANUAL (Ref 2.6) NOT
IN Manual PRINT-OUT
(SINCE 1982)

NOT TO BE REPRODUCED

UNCONTROLLED COPY



OR contain
requirements

PORC Meeting No. 82-18A

Reviewed: [Signature]
PORC Chairman

Approved: [Signature]
Plant Manager-
Nuclear

WATERFORD 3 SES
PLANT OPERATING MANUAL
CHANGE/REVISION/DELETION REQUEST

Procedure No. MM-6-017 Title Structural Bolt Tensioning
Effective Date N/A (if different from PM-N approval date)

Complete A, B, or C

A. Change No. 1
B. Revision No. 0
C. Deletion N/A

REASON FOR CHANGE, REVISION, OR DELETION

Reference to SAP-08, Condition Identification and Corrective Action or UNT5-002,
Condition Identification and Work Authorization, as applicable.

REQUIRED SIGNATURES

Originator Rudy Russo Date 10-31-82
Technical Review N/A RKC Date N/A RKC

SAFETY EVALUATION

Does this change, revision, or deletion:

	YES	NO
1. Change the facility as described in the FSAR?	<u>—</u>	<u>✓</u>
2. Change the procedures as described in the FSAR?	<u>—</u>	<u>✓</u>
3. Conduct tests/experiments not described in the FSAR?	<u>—</u>	<u>✓</u>
4. Create a condition or conduct an operation which exceeds, or could result in exceeding, the limits in Technical Specifications?	<u>—</u>	<u>✓</u>

1. Change the facility as described in the FSAR?
2. Change the procedures as described in the FSAR?
3. Conduct tests/experiments not described in the FSAR?
4. Create a condition or conduct an operation which exceeds, or could result in exceeding, the limits in Technical Specifications?

If the answer to any of the above is yes, complete and attach a 10 CFR 50.59 Safety Evaluation checklist.

Safety Evaluation Rudy Russo Date 10-25-82
Group/Dep't. Head Review N/A RKC Date N/A RKC
Temporary Approval* John J. Boyar Date 10-25-82 (NCS)
Temporary Approval* W. H. H. H. H. Date 10-25-82
QC Review W. H. H. H. H. Date 10-28-82
PORC Review W. H. H. H. H. Date 10/28/82 Meeting No. 82-410
Plant Manager-Nuclear Approval W. H. H. H. H. Date 10-28-82

*Temporary approval must be followed by Plant Manager-Nuclear approval within 14 days.

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LIST OF EFFECTIVE PAGES

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1.0 PURPOSE

- 1.1 The purpose of this procedure is to delineate the methods of tensioning ASTM A325 high-strength carbon steel bolts and A490 high-strength alloy steel bolts that are used in the assembly of structural steel joints.
- 1.2 This procedure is to be utilized in tensioning other types of structural fasteners to tension or torque values obtained from the specific construction or design documents.

2.0 REFERENCES

- 2.1 MM-1-002, Mechanical Maintenance Practices
 - 2.2 HP-1-110, Radiation Work Permits
 - 2.3 SAP-08, Condition Identification and Corrective Action
 - 2.4 UNT-7-006, Housekeeping
 - 2.5 American Institute of Steel Construction (AISC), Structural Joints Using ASTM A325 and A490 Bolts
 - 2.6 (LATER), Skidmore Wilhelm Torque Test Instruction Manual
 - 2.7 MM-1-004, Mechanical Maintenance Tool Room Control
 - 2.8 SAP-09, Tagging
 - 2.9 UNT-7-003, Control of Expendable Materials
 - 2.10 UNT-5-002, Condition Identification and Work Authorization.
- 3.0 PREREQUISITES

- 3.1 Obtain a Radiation Work Permit (RWP) in accordance with Reference 2.2, Radiation Work Permits, when designated on the Condition Identification Work Authorization (CIWA) of Reference 2.3, Condition Identification and Corrective Action, or Reference 2.10, Condition Identification and Work Authorization, as applicable.
- 3.2 The required components have been shut down and tagged in accordance with Reference 2.8, Tagging.
- 3.3 Other prerequisites as specified on the applicable CIWA.

4.0 PRECAUTIONS AND LIMITATIONS

- 4.1 Replacement parts shall be the same as or equivalent to the original parts.
- 4.2 Component repair documentation, hold point designation, personnel qualification requirements and other administrative functions shall be performed in accordance with Reference 2.1, Mechanical Maintenance Practices.
- 4.3 Ensure that area cleanliness is maintained in accordance with Reference 2.4, Housekeeping.
- 4.4 Bolt Tension
 - 4.4.1 Bolts shall be tightened in properly aligned holes.
 - 4.4.2 Tensioning methods may be performed by turning either the bolt or nut, whichever is more accessible when the other is prevented from rotating.
- 4.5 Calibrated Wrenches
 - 4.5.1 Torque wrenches used shall be calibrated and controlled in accordance with Reference 2.7, Mechanical Maintenance Tool Room Control.
 - 4.5.2 While in use, torque and impact wrenches shall be checked at least once each working day for each different bolt diameter being installed.

NOTE

Checking is defined as verification of the torque required to produce the bolt tension specified in Attachment 10.1, Structural Bolt Tensioning Chart.

- 4.5.3 If the surface condition of the bolts, nuts, or washers has deteriorated since the last time the torque and impact wrenches were checked, the wrenches shall be rechecked.
- 4.5.4 Checking of torque and impact wrenches shall be accomplished by tensioning three typical bolts of each bolt diameter with the Skidmore-Wilhelm Torque Test Machine. Results for the wrenches shall be entered on Attachment 10.3, Tensional Check of Torque and Impact Wrenches.
- 4.6 Bolt Reuse
- 4.6.1 Bolts used in checking wrenches shall be discarded.
- 4.6.2 A325 and A490 bolts ^{determined} removed from structural joints shall not be reused.
- 4.6.3 Retightening previously tightened bolts which may have been loosened by the tightening of adjacent bolts shall not be considered reuse.
- 4.7 Ensure that any beveled washers removed are reinstalled at the correct locations.
- 4.8 Bolted steel parts shall not be separated by gaskets in structural joints.
- 4.9 Cleaning shall be done with acetone or with an LP&L approved solvent in accordance with Reference 2.9, Control of Expendable Materials. Use lint-free cloths to ensure dryness after cleaning.
- 4.10 Other precautions and limitations as specified on the applicable CIWA.

5.0 INITIAL CONDITIONS

As specified on the applicable CIWA.

6.0 MATERIAL AND TEST EQUIPMENT

- 6.1 Torque wrenches
- 6.2 Torque multipliers
- 6.3 Adapters
- 6.4 Ratchets
- 6.5 Skidmore-Wilhelm Torque Tension Test Machine (Part No. LATER)
- 6.6 Assorted sockets
- 6.7 Impact wrenches
- 6.8 Suitable marking crayons
- 6.9 Spud wrenches

7.0 ACCEPTANCE CRITERIA

The required bolt tension shown on Attachment 10.1, Structural Bolt Tensioning Chart, has been applied to all bolts being installed.

8.0 PROCEDURE

NOTE

The Turn-of-Nut Method is the preferred method for tightening ASTM A325 and A490 bolts.

8.1 TENSIONING BY TURN-OF-NUT METHOD

- 8.1.1 Inspect all joint surfaces, including those adjacent to the bolt heads, nuts, or washers. Ensure that all parts and surfaces are free of scale (except tight mill scale), burrs, dirt, and other foreign material that would prevent solid seating of the parts. Clean, if necessary.
- 8.1.2 Install enough bolts to a "snug tight" condition so that the parts of the joint are brought into good contact with each other.

NOTE

"Snug tight" is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench.

- 8.1.3 Install the remaining bolts and tighten to "snug tight."

CAUTION

During tensioning there shall be no rotation of the part not turned by the wrench.

- 8.1.4 Bolt tensioning shall progress systematically from the most rigid part of the joint to its free edges.

- 8.1.5 Match mark the nut, bolt and the steel surface being bolted.

- 8.1.6 Tension all bolts in the joint by using the amount of nut rotation specified on Attachment 10.2, Nut Rotation for Tensioning by Turn-of-Nut Method.

- 8.1.7 Complete Attachment 10.4, Tensioning Data Sheet.

8.2 TENSIONING USING TORQUE OR IMPACT WRENCHES

- 8.2.1 Inspect all joint surfaces, including those adjacent to the bolt heads, nuts, or washers. Ensure that all parts and surfaces are free of scale (except tight mill scale), burrs, dirt, and other foreign material that would prevent solid seating of the parts. Clean, if necessary.

- 8.2.2 Install enough bolts to a "snug tight" condition so that the parts of the joint are brought into good contact with each other.

NOTE

"Snug tight" is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench.

- 8.2.3 Install the remaining bolts and tighten to "snug tight."
- 8.2.4 Match mark the nut, bolt and the steel surface being bolted.

CAUTION

During tensioning there shall be no rotation of the part not turned by the wrench.

- 8.2.5 Starting from the most rigid part of the joint, use one of the methods listed below to tension each bolt:
 - 8.2.5.1 Automatic Torque Control - Use of a torque control impact wrench with automatic cutoff, set to shut off at desired bolt tension in accordance with Attachment 10.3, Tensional Check of Torque and Impact Wrenches.
 - 8.2.5.2 Stall Torque Control - Use of an impact wrench with air pressure regulation set to "stall" at desired bolt tension in accordance with Attachment 10.3, Tensional Check of Torque or Impact Wrenches.
 - 8.2.5.3 Manual Torque Control - Use of a manual torque wrench to obtain a required average torque value as previously determined on Attachment 10.3, Tensional Check of Torque and Impact Wrenches.
- 8.2.6 Retension each bolt previously tightened to eliminate any relaxation caused by the tensioning of adjacent bolts.

8.2.7 Verify nut rotation from "snug tight" is within the limits specified on Attachment 10.2, Nut Rotation for Tensioning by Turn-of-Nut Method.

8.2.8 Complete Attachment 10.4, Tensioning Data Sheet.

9.0 SETPOINTS

None

10.0 ATTACHMENTS

10.1 Structural Bolt Tensioning Chart

10.2 Nut Rotation for Tensioning by Turn-of-Nut Method

10.3 Tensional Check of Torque and Impact Wrenches

10.4 Tensioning Data Sheet

11.0 COMMITMENTS AND REFERENCES

STRUCTURAL BOLT TENSIONING CHART

FASTENER TENSION

Nominal Bolt Size, Inches	Minimum Fastener Tension in Thousands of LBS (Kips)	
	A325 Bolts	A490 Bolts
1/2	13	16
5/8	20	25
3/4	29	37
7/8	41	51
1	54	67
1-1/8	59	84
1-1/4	75	107
1-3/8	89	127
1-1/2	108	155

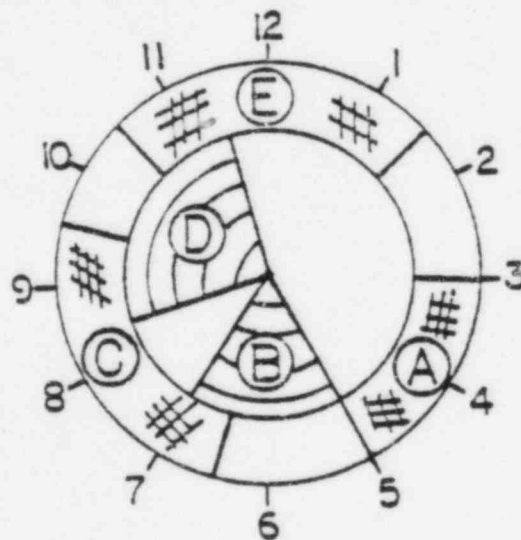
NUT ROTATION FOR TENSIONING BY TURN-OF-NUT METHOD

TABLE 1

Bolt length (from underside of head to extreme end point).	Disposition of outer faces of bolted parts		
	Column 1	Column 2	Column 3
	Both faces normal to bolt axis. (Use this column also if beveled washer has been used).	One face normal to bolt axis and other face sloped not more than 1.20 (bevel washer not used).	Both faces sloped not more than 1.20 from normal to bolt axis (bevel washers not used).
Up to and including 4 diameters	1/3 turn (A)*	1/2 turn (B)*	2/3 turn (C)*
Over 4 diameters, but not exceeding 8 diameters.	1/2 turn (B)*	2/3 turn (C)*	5/6 turn (D)*
Over 8 diameters but not exceeding 12 diameters.	2/3 turn (C)*	5/6 turn (D)*	1 turn (E)*

* Nut rotation from "snug-tight" condition is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts being installed by 1/2 turn or less, the tolerance should be plus or minus 30°; for bolts installed by 2/3 turn and more, the tolerance should be plus or minus 45°. Letters in parenthesis indicate tolerance bands shown below.

FIG.1
TOLERANCES FOR TURN-OF-NUT METHOD

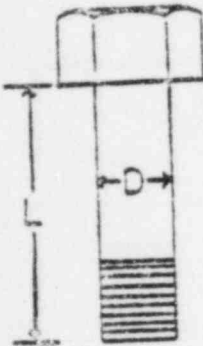


Nut Rotation for Tensioning by Turn-of-Nut Method

Example

It is desired to install ASTM A325, 1-7/8" long by 3/4" diameter bolts.

1. Determine the 'number of diameters' as follows:



$L = \text{bolt length} = 1-7/8"$

$D = \text{bolt diameter} = 3/4"$

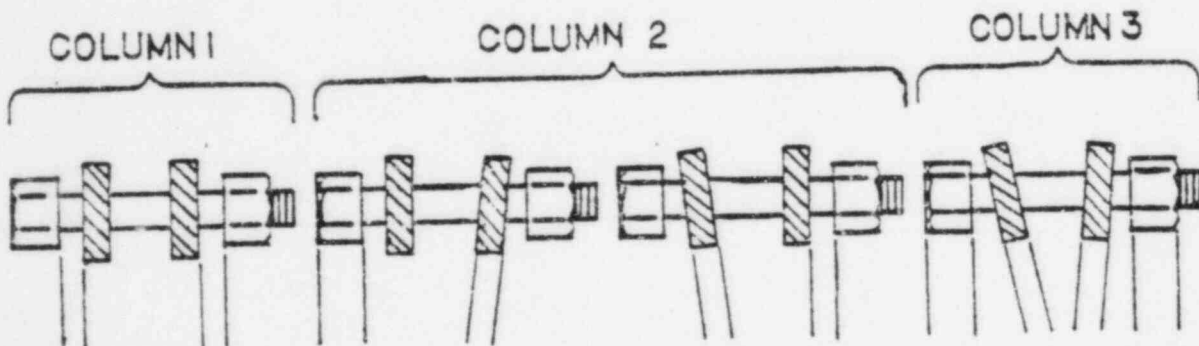
$L = \text{Number of Diameters}$

D

$$\frac{1-7/8}{3/4} = \frac{15/8}{3/4} = \frac{15}{8} \times \frac{4}{3} = \frac{5}{2} = 2.5$$

Number of diameters = 2.5

2. From the value calculated above (2.5), determine the correct row to use under 'Bolt Length' in Table 1. In this case, "Up to and including 4 diameters" is the correct row.
3. Now determine from the figures below the relationship between the bolt head, nut and the seating surfaces.



In this case, let's say that the bolt head and nut are parallel to the seating surfaces as in Column 1 above.

Nut Rotation for Tensioning
by Turn-of-Nut Method

4. Using Table 1 under Column 1 (Both faces normal to bolt axis), determine the amount of required nut rotation for the correct row (step 2).

Nut rotation = $1/3$ turn

This means that the nut should be tightened from the 'snug-tight' condition, $1/3$ of a turn.

5. The nut should be rotated as close to $1/3$ of a turn as possible, however some tolerances are allowed. This tolerance is indicated by the 'A' under Column 1 and is shown in Figure 1. This means that the nut should be rotated between 3 and 5 o'clock as shown by the shaded area labelled 'A'.

TENSIONAL CHECK OF TORQUE AND IMPACT WRENCHES

1. Bolt Grade: _____ 2. Bolt Size: _____
3. Recommended Minimum Tension (Attachment 10.1) _____ kips
- .. Torque Wrench Check using the Skidmore-Wilhelm Torque Test Machine, M&TE No. (____Later____)

A. Perform three tests using three typical bolts and record the following:

	Tension Kips		Torque Wrench Reading (ft-lbs)
	Minimum	Actual	
	Required	(measured)	
Test No. 1 _____	_____	_____	T1=_____
Test No. 2 _____	_____	_____	T2=_____
Test No. 3 _____	_____	_____	T3=_____

B. Calculate Average Torque (Tavg) as follows:

$$T_{avg} = \frac{T1 + T2 + T3}{3} = \text{_____ ft-lbs}$$

Torque Wrench M&TE No. _____

Torque Multiplier(s) M&TE No. _____

5. Impact Wrench Check using the Skidmore-Wilhelm Torque Test Machine, M&TE No. (Later)

- A. Using a typical bolt (same diameter/length of bolts to be installed), perform a preliminary adjustment of the impact wrench shutoff.
- B. With the impact wrench shutoff adjusted, perform three tests using three typical bolts and record the following:

Tension Kips

	Minimum Required	Actual (Measured) <u>*at Impact Wrench Shutoff</u>
Test No. 1	_____	_____
Test No. 2	_____	_____
Test No. 3	_____	_____

*All 'actual (measured)' readings at shutoff must be greater than the 'minimum required' and the difference between the highest and lowest 'actual (measured)' readings must be less than 1% of the 'minimum required.'

Performed By _____ Date _____

Reviewed By _____ Date _____

Mechanical Maintenance
Supervisor

TENSIONING DATA SHEET

1. Tensioned Item/Location _____

2. Stud/Bolt dia. _____ in., Qty _____
3. Final tension reqmt. _____ Kips, Per dwg _____ Rev _____
4. Required nut/bolt rotation _____ turns.
5. Sketch stud/bolt pattern and sequence numbers:

6. Tensioning Data

Tensioning		Tensioning		Tensioning		Tensioning	
Bolt	Completed	Bolt	Completed	Bolt	Completed	Bolt	Completed
No.	(Initials)	No.	(Initials)	No.	(Initials)	No.	(Initials)

ASSIGNED AUTHOR

SYSTEM *SRV*
MAJOR COMPONENT *SRV AND 11CB*

MAINTENANCE RECORD

[illegible]

F01A-84-206

10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-100-101-102-103-104-105-106-107-108-109-110-111-112-113-114-115-116-117-118-119-120-121-122-123-124-125-126-127-128-129-130-131-132-133-134-135-136-137-138-139-140-141-142-143-144-145-146-147-148-149-150-151-152-153-154-155-156-157-158-159-160-161-162-163-164-165-166-167-168-169-170-171-172-173-174-175-176-177-178-179-180-181-182-183-184-185-186-187-188-189-190-191-192-193-194-195-196-197-198-199-200-201-202-203-204-205-206-207-208-209-210-211-212-213-214-215-216-217-218-219-220-221-222-223-224-225-226-227-228-229-230-231-232-233-234-235-236-237-238-239-240-241-242-243-244-245-246-247-248-249-250-251-252-253-254-255-256-257-258-259-260-261-262-263-264-265-266-267-268-269-270-271-272-273-274-275-276-277-278-279-280-281-282-283-284-285-286-287-288-289-290-291-292-293-294-295-296-297-298-299-300-301-302-303-304-305-306-307-308-309-310-311-312-313-314-315-316-317-318-319-320-321-322-323-324-325-326-327-328-329-330-331-332-333-334-335-336-337-338-339-340-341-342-343-344-345-346-347-348-349-350-351-352-353-354-355-356-357-358-359-360-361-362-363-364-365-366-367-368-369-370-371-372-373-374-375-376-377-378-379-380-381-382-383-384-385-386-387-388-389-390-391-392-393-394-395-396-397-398-399-400-401-402-403-404-405-406-407-408-409-410-411-412-413-414-415-416-417-418-419-420-421-422-423-424-425-426-427-428-429-430-431-432-433-434-435-436-437-438-439-440-441-442-443-444-445-446-447-448-449-450-451-452-453-454-455-456-457-458-459-460-461-462-463-464-465-466-467-468-469-470-471-472-473-474-475-476-477-478-479-480-481-482-483-484-485-486-487-488-489-490-491-492-493-494-495-496-497-498-499-500-501-502-503-504-505-506-507-508-509-510-511-512-513-514-515-516-517-518-519-520-521-522-523-524-525-526-527-528-529-530-531-532-533-534-535-536-537-538-539-540-541-542-543-544-545-546-547-548-549-550-551-552-553-554-555-556-557-558-559-560-561-562-563-564-565-566-567-568-569-570-571-572-573-574-575-576-577-578-579-580-581-582-583-584-585-586-587-588-589-590-591-592-593-594-595-596-597-598-599-600-601-602-603-604-605-606-607-608-609-610-611-612-613-614-615-616-617-618-619-620-621-622-623-624-625-626-627-628-629-630-631-632-633-634-635-636-637-638-639-640-641-642-643-644-645-646-647-648-649-650-651-652-653-654-655-656-657-658-659-660-661-662-663-664-665-666-667-668-669-670-671-672-673-674-675-676-677-678-679-680-681-682-683-684-685-686-687-688-689-690-691-692-693-694-695-696-697-698-699-700-701-702-703-704-705-706-707-708-709-710-711-712-713-714-715-716-717-718-719-720-721-722-723-724-725-726-727-728-729-730-731-732-733-734-735-736-737-738-739-740-741-742-743-744-745-746-747-748-749-750-751-752-753-754-755-756-757-758-759-760-761-762-763-764-765-766-767-768-769-770-771-772-773-774-775-776-777-778-779-780-781-782-783-784-785-786-787-788-789-790-791-792-793-794-795-796-797-798-799-800-801-802-803-804-805-806-807-808-809-810-811-812-813-814-815-816-817-818-819-820-821-822-823-824-825-826-827-828-829-830-831-832-833-834-835-836-837-838-839-840-841-842-843-844-845-846-847-848-849-850-851-852-853-854-855-856-857-858-859-860-861-862-863-864-865-866-867-868-869-870-871-872-873-874-875-876-877-878-879-880-881-882-883-884-885-886-887-888-889-890-891-892-893-894-895-896-897-898-899-900-901-902-903-904-905-906-907-908-909-910-911-912-913-914-915-916-917-918-919-920-921-922-923-924-925-926-927-928-929-930-931-932-933-934-935-936-937-938-939-940-941-942-943-944-945-946-947-948-949-950-951-952-953-954-955-956-957-958-959-960-961-962-963-964-965-966-967-968-969-970-971-972-973-974-975-976-977-978-979-980-981-982-983-984-985-986-987-988-989-990-991-992-993-994-995-996-997-998-999-1000-1001-1002-1003-1004-1005-1006-1007-1008-1009-1010-1011-1012-1013-1014-1015-1016-1017-1018-1019-1020-1021-1022-1023-1024-1025-1026-1027-1028-1029-1030-1031-1032-1033-1034-1035-1036-1037-1038-1039-1040-1041-1042-1043-1044-1

WELLS
LBS

MAJOR COMPONENT SBT

101A

ATTACHMENT

MAJOR COMPONENT 537 DIV 101B

MAINTENANCE RECORD

[illegible]

カニノミヅナ

R TYPE P2.09

MAINTENANCE RECORD

SYSTEM *SBV*
MAJOR COMPONENT *SBV INACB 114A*

[illegible]

MAINTENANCE RECORD

3.111 2.024

SYSTEMS, INC.

MAJOR COMPONENT 585-1143 143

[illegible]

SYSTEM *SBV*
MAJOR COMPONENT *SBV* *ML4029* *13A*

in TYPE P2.09

WALSLEY SYSTEMS

MAJOR COMPONENT

[illegible]

MAINTENANCE RECORD

SYSTEM *88V*
MAJOR COMPONENT *88V - 12V 400 113B*

[illegible]

