Underground Injection Control
Carbon Sequestration
Class VI Permit Application

PLUGGING PLAN
40 CFR 146.82(7) & (10)
Section 9.0

Tallgrass High Plains Carbon Storage, LLC
Western Nebraska Sequestration Hub

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9.0 INJECTION WELL PLUGGING PLAN

WESTERN NEBRASKA SEQUESTRATION HUB

FACILITY INFORMATION

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Conestoga I-1

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Well location: Kimball County, Nebraska
[redacted]

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ACRONYMS AND ABBREVIATIONS

B	
BHP	bottomhole pressure
BOP	blowout preventer
BTC	buttress thread coupling
C	
CBL	cement bond log
CFR	Code of Federal Regulations
CO_2	carbon dioxide
E	
EPA	U.S. Environmental Protection Agency
F	
ft	feet/foot
I	
ID	inner diameter
in.	inches
K	
KB	kelly bushing
M	
MIRU	move in and rig up
MIT	mechanical integrity test
N	
NAC	Nebraska Administrative Code
NOGC	Nebraska Oil and Gas Commission
O	
OD	outer diameter
P	
PBTD	plug-back total depth
POOH	pull out of hole
R	
RIH	run in hole
T	
TH.	thickness
TWCV	two-way check valve
U	
UIC	Underground Injection Control
USDW	Underground Source of Drinking Water
USIT	ultrasonic imaging tool
W	
WT	weight

9.0 PLUGGING PLAN

This section outlines the plugging and abandonment plans for the Conestoga I-1 and Conestoga M-1 wells. The monitoring well (Conestoga M-1) will be plugged following the post-injection site care (PISC) period. High Plains plans to convert the injection well (Conestoga I-1) to an in-zone monitoring well after the injection period. Thus, it will be plugged at the end of the PISC period. Both wells will be plugged and abandoned under the requirements of Nebraska Administrative Code (NAC) Title 267 and CFR §146.92. In addition to regulatory requirements, engineering and operational best practices, as well as industry standards, will be applied during the plugging program to prevent contamination of underground sources of drinking water (USDW).

The pre- and post-plugging plans, including permits, notification, the planned wellbore preparation, and final plugging and abandonment procedures for Conestoga I-1 and M-1 are provided in *Sections 9.1* and *9.2* of this document.

Following completion of the abandonment operations, a record of the work performed (Form 6) will be submitted to the Director of the Nebraska Oil and Gas Commission (NOGC) within 30 days of the plugging date, in accordance with NAC Title 267, Chapter 3, Section 7**.**

9.1 Injection Well Plugging Plans

9.1.1 Planned Tests or Measures to Determine Bottomhole Reservoir Pressure

Bottomhole pressure will be measured with a wireline gauge run through tubing. The well shall be shut in for a sufficient amount of time prior to the test to ensure the reservoir pressure has stabilized.

1. Shut in well for a sufficient amount of time to stabilize (NAC 267.026 states a minimum of 24 hours).
2. Move in, rig up (MIRU) wireline
3. Run in hole (RIH) with wireline, through tubing, to the top of the perforated interval and obtain pressure readings
4. Pull out of hole (POOH).
5. Use bottomhole pressure (BHP) readings to determine reservoir pressure

9.1.2 Planned External Mechanical Integrity Test(s)

External mechanical integrity will be demonstrated through approved temperature or acoustic logging methods. High Plains will conduct at least one of the tests listed in **Table 9.1** to verify external mechanical integrity prior to plugging the injection well as required by 40 CFR 146.92(a).

Table 9.1—Planned mechanical integrity tests prior to plugging the injection well.

Test Description	Locations
Casing Pressure Test	The casing by tubing annulus will be pressure-tested to 500 psi for 30 minutes. A passing test will show no discernable drop in pressure (< 10%) over the test period.
Temperature/Acoustic Log	Wireline conveyed temperature survey through tubing. A passed test shows no temperature anomalies which may indicate fluid or gas movement behind the casing.
[redacted]	

The following procedure is an example of how to demonstrate mechanical integrity, release packer, recover tubing, and clean out the wellbore.

Pre- Plugging Procedures

1. Shut in injection well and MIRU workover rig and equipment.
2. Kill and flush well.
    a. Determine appropriate CO_2-compatible fluid based on BHP reading.
    b. Bullhead buffer fluid selected based on BHP down [redacted] production tubing.
    c. Pump wellbore volume plus 50 barrels (bbl) to flush into formation.
    d. Ensure well is static.
3. Install two-way check valve (TWCV) in the tubing hanger.
4. Nipple-down the wellhead.
5. Nipple-up the blowout preventer (BOP).
6. Function test and pressure test the BOP.
    a. No discernable decline in pressure is allowable while testing BOP equipment
    b. Document pressure and times on the daily reports or provide third-party test reports with daily reports
7. Bleed pressure, remove test joint and TWCV.
8. MIRU wireline, pressure control equipment, and logging tools.
9. Perform approved temperature or acoustic logging to confirm wellbore integrity.
10. If integrity cannot be confirmed, prepare and submit a remediation plan for approval.
11. Pressure test casing (tubing-casing annulus) with packer fluid to ensure integrity. Pressure test shall be lower than 90% of the injection zone's fracture gradient.
12. Run tubing punch on wireline and punch tubing above the packer. Rig down wireline.
13. Circulate well and tubing annulus with kill weight fluid.
14. Make up a landing joint to tubing hanger and attempt to release retrievable packer
    a. If packer cannot be retrieved, cut and pull tubing as deep as possible, then attempt to fish packer out of hole
        i. If the packer cannot be fished out of hole, RIH with a milling assembly and attempt to reach the plugback total depth.
15. POOH laying down tubing and packer.
16. Pick up [redacted] in. casing scraper and workstring.
17. RIH with casing scraper to the top perforation.
18. POOH, racking back the workstring.

19. Rig up wireline pressure control equipment and logging tools.
20. Run casing inspection log and cement bond log.
21. Rig down wireline.
22. Evaluate logs and confirm wellbore integrity.

9.1.3 Information on Plugs for Injection Well Abandonment

High Plains will use the materials and methods noted in **Table 9.2** to plug the injection well. The volume and depth of the plug or plugs will depend on the final geology and downhole conditions of the well as assessed during construction. The cement(s) formulated for plugging across and immediately above the injection zone will be compatible with the CO_2 stream. The cement formulation and required certification documents will be submitted to the agency with the well plugging plan. High Plains will report the measured density and will retain samples of the cement used for each plug. **Table 9.3** provides a summary of the cement plugs for the injection well abandonment.

Volume calculations for these plugs have been calculated using the inner diameter of each string (per the casing specification sheet) and the lengths of plugs planned. The volumes have been adjusted to reflect the excess percentage to be pumped, when relevant. The yield was assumed to be [redacted] ft^3/sack for the calculation of cement sacks for each job.

Table 9.2—Plugging details for Conestoga I-1.

Plug Information	Plug No. 1	Plug No. 2	Plug No. 3	Plug No. 4	Plug No. 5
Diameter of boring or casing in which plug will be placed (in.)	[redacted]				
Depth to bottom of tubing or retainer (ft)					
Approximate sacks of cement to be used					
Slurry volume to be pumped (ft^3)					
Slurry weight (lbm/gal)					
Calculated top of plug (ft)					
Bottom of plug (ft)					
Type of cement or other material					
Method of emplacement (e.g., balance method, retainer method, or two-plug method)					

Table 9.2 (cont.)—Plugging details for Conestoga I-1.

Plug Information	Plug No. 6	Plug No. 7	Plug No. 8	Plug No. 9	Plug No. 10
Diameter of boring or Casing in which plug will be placed (in.)	[redacted]				
Depth to bottom of tubing or retainer (ft)					
Approximate sacks of cement to be used					
Slurry volume to be pumped (ft^3)					
Slurry weight (lbm/gal)*					
Calculated top of plug (ft)					
Bottom of plug (ft)					
Type of cement or other material					
Method of emplacement (e.g., balance method, retainer method, or two-plug method)					

Note: A yield of [redacted]/sack has been assumed for the slurry volume calculation; lbm/gal = pound-mass per gallon

Table 9.3—Summary of cement plugs for the Conestoga I-1 plug and abandonment.

Cement Plug Number	Interval Range (ft)	Thickness (ft)	Volume (ft^3)	Note
[redacted]				

9.1.4 Narrative Description of Plugging Procedures

Notifications, Permits, and Inspections

In compliance with 40 CFR 146.92(c), High Plains will notify the regulatory agency at least 60 days before plugging the well and provide an updated Injection Well Plugging Plan, if necessary.

Issue Notifications and Obtain Permits/Approval

- In compliance with 40 CFR 146.92(c), High Plains will notify the UIC Director at least 60 days before plugging the well, and provide an updated Well Plugging Plan, if applicable.
- Notification shall be given to the NOGCC Director by submitting Form 4, "Sundry Notices" with the required details, payments of required fees, and the Director's approval must be obtained prior to the commencement of plugging operations (NAC T.267.003.28).
- Within 30 days after the abandonment a detailed report of the work done and the results obtained will be submitted, as Form 6, to the NOGCC Director (NAC T.267.003.05).

Injection Well Plugging Procedures

Injection and Confining Zone Plug

[redacted]

Injection Well Abandonment Design

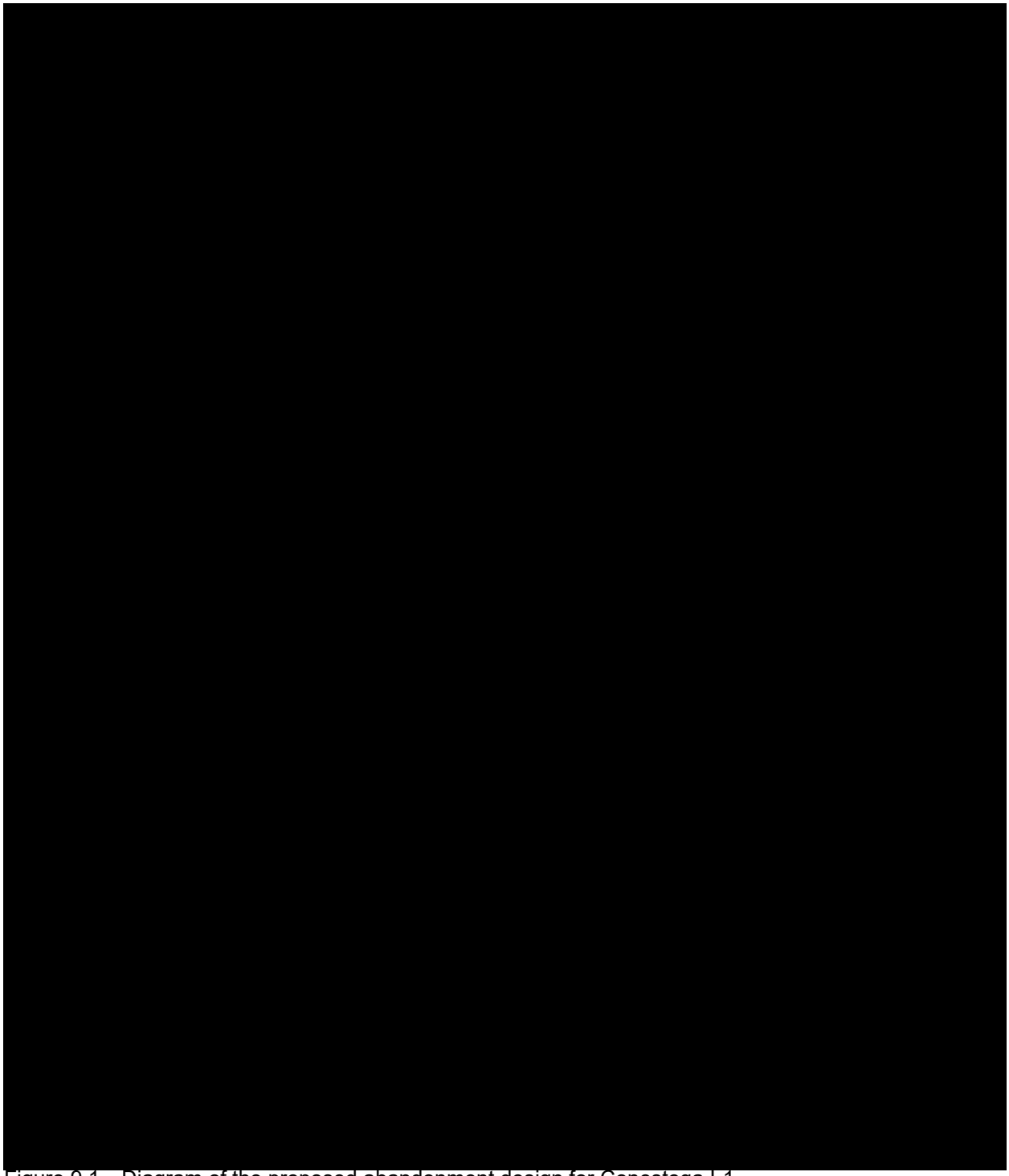

Figure 9.1—Diagram of the proposed abandonment design for Conestoga I-1.

9.2 Monitoring Well Plugging Plan

9.2.1 Bottomhole Pressure Determination

This well is to serve as a monitoring well with pressure gauges cemented outside the [redacted]

9.2.2 External Mechanical Integrity Testing

External mechanical integrity will be demonstrated through approved temperature logging methods.

1. MIRU wireline BOP and lubricator.
2. Perform approved temperature logging to confirm wellbore integrity.
3. MIRU a workover rig and ancillary equipment.
4. Install and test a BOP.
5. Pick up and RIH with a workstring to PBTD.
   i) Make a clean out run if unable to reach PBTD
6. Pressure test casing to 500 psi for 30 mins to ensure integrity.
7. POOH, racking back workstring and laying down string.
8. Rig up wireline, pressure control equipment and logging tools.
9. Run casing inspection log and cement bond log.
10. Evaluate logs and confirm wellbore integrity.

9.2.3 Information on Plugs for Monitoring Well Abandonment

High Plains will use the materials and methods noted in **Table 9.2** to plug the monitoring well. The volume and depth of the plug or plugs will depend on the final geology and downhole conditions of the well as assessed during construction. The cement(s) formulated for plugging will be compatible with the carbon dioxide stream across the confining and injection zones. The cement formulation and required certification documents will be submitted to the agency with the well plugging plan. High Plains will report the wet density and will retain duplicate samples of the cement used for each plug. **Table 9.4** provides a summary of the cement plugs for the injection well abandonment.

Volume calculations for these plugs have been determined using the inner diameter of each string, casing capacities, and the planned plug lengths. The volumes have been adjusted to reflect the excess by percent when relevant, and the yield was assumed to be [redacted] ft^3/sack for the calculation of cement sacks for each job.

Table 9.4—Plugging details for the Conestoga M-1.

Plug Information	Plug No. 1	Plug No. 2	Plug No. 3	Plug No. 4	Plug No. 5
Diameter of boring or Casing in which plug will be placed (in)	[redacted]				
Depth to bottom of tubing or retainer (ft)					
Approximate sacks of cement to be used					
Slurry volume to be pumped (ft^3)					
Slurry weight (lbm/gal)					
Calculated top of plug (ft)					
Bottom of plug (ft)					
Type of cement or other material					
Method of emplacement (e.g., balance method, retainer method, or two-plug method)					

Table 9.4—Plugging details for the Conestoga M-1 (cont.)

Plug Information	Plug No. 6	Plug No. 7	Plug No. 8	Plug No. 9
Diameter of boring or Casing in which plug will be placed (in)	[redacted]			
Depth to bottom of tubing or retainer (ft)				
Approximate sacks of cement to be used				
Slurry volume to be pumped (ft^3)				
Slurry weight (lbm/gal)				
Calculated top of plug (ft)				
Bottom of plug (ft)				
Type of cement or other material				
Method of emplacement (e.g., balance method, retainer method, or two-plug method)				

Note: A yield of [redacted]/sack has been assumed for the slurry volume calculation; lbm/gal = pound-mass per gallon

Table 9.5—Summary of cement plugs for the Conestoga M-1 plug and abandonment.

Cement Plug Number	Interval Range (ft)	Thickness (ft)	Volume (ft^3)	Note
[redacted]				

9.2.4 Narrative Description of Plugging Procedures

Notifications, Permits, and Inspections

In compliance with 40 CFR 146.92(c), High Plains will notify the regulatory agency at least 60 days before plugging the Conestoga M-1 and provide an updated Plugging Plan, if necessary.

Issue Notifications and Obtain Permits/Approval

- Notification shall be given to the NOGCC Director by submitting Form 4, "Sundry Notices" with the required details, payments of required fees, and the Director's approval must be obtained prior to the commencement of plugging operations (NAC T.267.003.28).
- Within 30 days after the abandonment a detailed report of the work done and the results obtained will be submitted, as Form 6, to the NOGCC Director (NAC T.267.003.05).

Monitoring Well Plugging Procedures

Set Acid Resistant Plug

[redacted]

[redacted]

Monitoring Well Abandonment Design

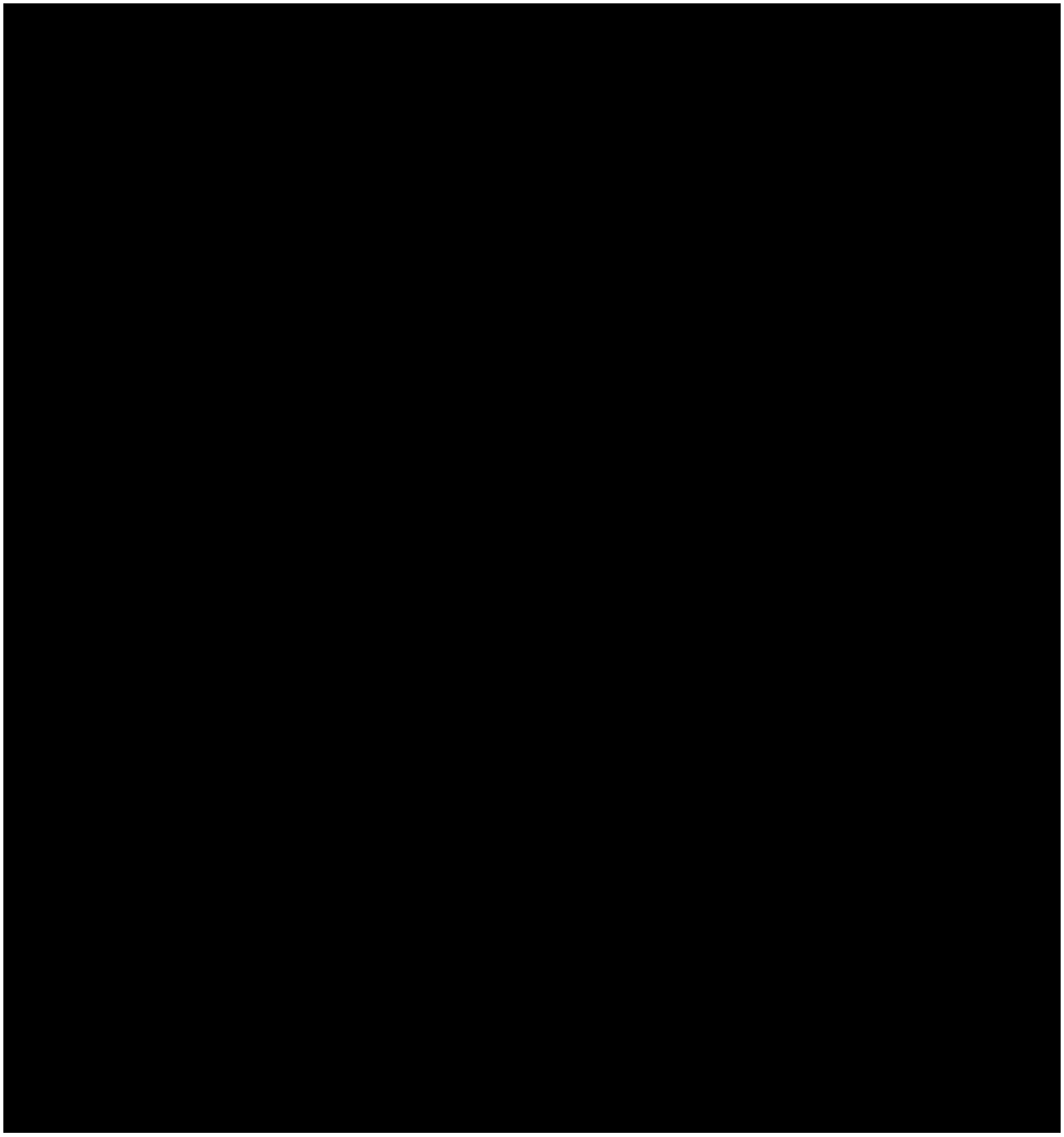

Figure 9.2—Diagram of the proposed abandonment configuration for the Conestoga M-1.