

Fujitsu Enterprise Postgres 17 for Kubernetes

Reference

Linux

Preface

Purpose of this document

This document is a reference, and explains parameter.

Intended readers

This document is aimed at people who manage and operate.

Readers of this document are also assumed to have general knowledge of:

- Linux
- Kubernetes
- Containers
- Operators

Structure of this document

This document is structured as follows:

[Chapter 1 Custom Resource Parameters](#)

Explains the parameter.

[Appendix A Default Metrics Queries](#)

Explains the Default Metrics Queries

[Appendix B Default Alert Rules](#)

Explains the Default Alert Rules

[Appendix C Operator Operation Event Notification](#)

Explains the Operator Operation Event Notification

Abbreviations

The following abbreviations are used in this manual:

Full Name	Abbreviations
Fujitsu Enterprise Postgres for Kubernetes Fujitsu Enterprise Postgres	FEP
Transparent Data Encryption	TDE
Custom Resource	CR
Custom Resource Definition	CRD
Persistent Volume	PV

Abbreviations of manual titles

The following abbreviations are used in this manual as manual titles:

Full Manual Title	Abbreviations
Fujitsu Enterprise Postgres for Kubernetes User's Guide	User's Guide

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Issue date and version

Edition 1.0: November 2024

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Chapter 1 Custom Resource Parameters

This chapter explains the parameter.

1.1 FEPCluster Parameter

Equivalent Kubernetes command: `kubectl apply -f FEPClusterCR.yaml`

This operation will create a FEPCluster with supplied information in FEPClusterCR.yaml.

Initial configuration and subsequent changes to FEP Cluster are done through FEP Cluster CR.

Field	Default	Details
metadata.name	new-fep	Name for the Cluster. FEP server container will use this value for Patroni scope. e.g. new-fep
spec.fep.autoPodRestart	<omitted>	Optional This parameter affects the behaviour when value(s) of CPU, memory and/or image for FEP and/or optional Backup container are updated in FEPCluster CR. If it is NOT defined and set to true, operator will automatically create an action CR to make values effective by restarting all pods in an orderly fashion to minimise outage. If it is set to false, automatic restart of PoDs will NOT happen. To make the changes effective, user must restart pods by creating action CR with type 'pod_restart' and arguments 'ALL'
spec.fep.fepVersion	<omitted>	Optional When deploying a new FEP cluster, this parameter controls which FEP major version will be used for the deployment. If not specified, Operator will use latest FEP version supported by the Operator. When fepVersion is defined but not spec.fep.image.image, Operator will deploy the specific version of FEP. When both fepVersion and image are defined, Operator will use the image and discard the value of fepVersion. Current support value: 13, 14, 15, 16, 17 Note: Changing fepVersion from one version to another version is not supported after deployment.

Field	Default	Details
spec.fep.customAnnotation.allDeployments	{ } (*)	Contents under this are optional. User can remove { } and add multiple key-value pairs. All of these pair will be added to annotations of FEP statefulSet and FEP Pods. If left at default, no annotation is added to Pods and statefulSets
spec.fep.image.image	<omitted>	FEP server container image to be used quay.io/fujitsu/fujitsu-enterprise-postgres-17-server:ubi9-17-1.0 It is optional Image line is omitted by default. This key has a higher precedence than fepVersion. If both fepVersion and image are omitted, Operator will use the latest FEP version that it supports. If both fepVersion and image are specified, Operator will use the specified image and ignore the value in fepVersion.
spec.fep.image.pullPolicy	IfNotPresent	
spec.fep.mcSpec.limits	cpu: 500m memory: 700Mi (If spec.fep.databaseSize is medium) cpu: 2 memory: 4Gi (If spec.fep.databaseSize is large) cpu: 4 memory: 16Gi	
spec.fep.mcSpec.requests	cpu: 200m memory: 512Mi (If spec.fep.databaseSize is medium) cpu: 1 memory: 2Gi (If spec.fep.databaseSize is large) cpu: 2 memory: 8Gi	
spec.fep.databaseSize		Specifiable values: small, medium, large The operator defines the values for cpu, memory, and postgresql.conf, matching the specified values. If the target parameter is defined, it is not overwritten. Can be set only when creating

Field	Default	Details
		FEPCluster custom resource. After you create a FEPCluster custom resource, you customize it by editing each parameter.
spec.fep.sysExtraLogging	false	To turn extra debugging on, set value to true It can be turned on/off at any time
spec.fep.sysExtraEvent	false	Options To turn on event notification for custom resource changes, set the value to true. You can turn it on or off at any time.
spec.fep.instances	1	Number of nodes in the cluster, including both Master and Replicas. In Example CR, it is kept at 1 for certification. However, user can change it to 3 for 1 master and 2 replicas.
spec.fep.servicePort	27500	TCP port for FEP master service
spec.fep.syncMode	off	Replication Mode: off - async replication on - sync replication
spec.fep.standby.enable	false	This parameter enables the hot standby configuration. Enabled at true.
spec.fep.standby.method		Specifies the method for achieving a hot standby configuration. archive-recovery - Uses continuous recovery. streaming - Uses streaming replication.
spec.fep.standby.pgBackrestConf		Required for both continuous recovery and streaming replication methods. You must specify the backup storage on which the production environment is backed up. AWS S3 and Azure Blob Storage are available.
spec.fep.standby.streaming.host		Specify this option to use the streaming replication method. Specify the external IP of the LoadBalancer you created in "Defining a Streaming Replication Method" in the User's Guide.
spec.fep.standby.streaming.port		Specify this option to use the streaming replication method. Specify the port defined in the LoadBalancer you created in "Defining a Streaming Replication Method" in the User's Guide.
spec.fep.forceSsl	true	Controls the use of SSL only for communication between FEPCluster

Field	Default	Details
		containers. The changes are reflected in pg_hba.conf. Changing this parameter is not reflected in pg_hba.conf if the automatic certificate generation feature is enabled.
spec.fep.locale	<omitted> (*)	Optional Can only be specified when creating a FEPCluster. Database Cluster Locale Settings: ja_JP - Japanese locale Default - C
spec.fep.monitoring		This is an Optional section. This defines whether monitoring enabled(true) or disabled(false) , MTLs enabled or disabled & Basic authentication enabled or not
spec.fep.monitoring.enable	false	If set true, the operator will create FEPEXporter with given spec
spec.fep.monitoring.fepExporter		This is Optional section. Exporter spec section applied only if enable: true
spec.fep.monitoring.fepExporter.authSecret		This is Optional section. Base Authentication secret to provide username & encrypted password of user
spec.fep.monitoring.fepExporter.authSecret.secretName	(created by user)	Mandatory Name of secret that contains username and password
spec.fep.monitoring.fepExporter.authSecret.userKey	(created by user)	Mandatory Key of username in specified secret
spec.fep.monitoring.fepExporter.authSecret.passwordKey	(created by user)	Mandatory Key of password in specified secret
spec.fep.monitoring.fepExporter.tls		This is optional section. FEPEXporter MTLs specs. Mandatory if tls specs defined for Prometheus specs
spec.fep.monitoring.fepExporter.tls.certificateName	(created by user)	Mandatory.This points to Kubernetes TLS secret that contains the certificate of FepExporter. Prometheus will use this for certificate authentication. The certificate itself is stored in the key tls.crt.
spec.fep.monitoring.fepExporter.tls.caName	(created by user)	Mandatory This points to Kubernetes configmap that contains additional CA the client use to verify a server certificate. The CA is stored in the key ca.crt.

Field	Default	Details
spec.fep.monitoring.fepExporter.customLabel		Optional List of key value pair to be added to Prometheus ServiceMonitor label. The following label will always be added to ServiceMonitor, regardless if a value is specified here or not. fepsmgrp: sm-fep-exporter
spec.fep.monitoring.prometheus		This is Optional section. Prometheus specs are mandatory if tls specs defined for FEPEXporter
spec.fep.monitoring.prometheus.tls		Prometheus MTLs specs
spec.fep.monitoring.prometheus.tls.certificateName	(created by user)	This is an Optional parameter. These points to Kubernetes TLS secret that contains the certificate of Prometheus. FEPEXporter will use this for certificate authentication. The certificate itself is stored in the key tls.crt.
spec.fep.monitoring.prometheus.tls.caName	(created by user)	This is an Optional parameter. This point to Kubernetes configmap that contains additional CA the client use to verify a server certificate. The CA is stored in the key ca.crt.
spec.fep.externalMonitoring.cloudWatch		This is an Optional section. Define this option when linking with CloudWatch.
spec.fep.externalMonitoring.cloudWatch.enable	true	Optional A value of true forwards Fujitsu Enterprise Postgres metrics to CloudWatch. Specify false to cancel log transfer.
spec.fep.externalMonitoring.cloudWatch.schedule	"0-59/10 * * * *"	You can specify how often to transfer. Specified as a Cron value.
spec.fep.externalMonitoring.cloudWatch.namespace		Specifies the CloudWatch Namespace to which metrics are forwarded. Required if spec.fep.externalMonitoring.cloudWatch is specified
spec.fep.externalMonitoring.cloudWatch.defaultMetrics	true	Specify true to capture and forward the metrics described in "Metrics Collected by CloudWatch" in the User's Guide. Specify false to forward only custom metrics to CloudWatch.
spec.fep.externalMonitoring.cloudWatch.customMetrics		Optional If you want to forward custom metrics, specify the ConfigMap name where you defined the custom metrics.
spec.fep.externalMonitoring.cloudWatch.dimensionName		Optional

Field	Default	Details
		If adding a Dimension, specify a name of your choice. If dimensionValue is omitted, this value is ignored.
spec.fep.externalMonitoring.cloudWatch.dimensionValue		Optional If adding a Dimension, specify any value. If dimensionName is omitted, this value is ignored.
spec.fep.externalMonitoring.cloudWatch.authentication.cloudWatchCredentials		Specify a secret name that defines a credentials for a role that has permission to forward metrics to CloudWatch. Required if spec.fep.externalMonitoring.cloudWatch is specified
spec.fep.externalMonitoring.cloudWatch.authentication.cloudWatchConfig		Specify a ConfigMap name that defines the config information for a role that has permission to forward metrics to CloudWatch. Required if spec.fep.externalMonitoring.cloudWatch is specified
spec.fep.externalMonitoring.cloudWatch.databases	postgres	Specifies the databases from which to collect metrics, in list format. The default is to collect metrics from the postgres database.
spec.fep.podAntiAffinity	false	Defines that all the pods should not run on same worker node
spec.fep.podDisruptionBudget	false	Allows to maintain minimum number of pods of an application even when some nodes are voluntarily drained for say, maintenance
spec.fep.replicationSlots		List of Patroni permanent replication slots.
spec.fep.replicationSlots.demo_subscription1		The 'demo_subscription1' is the slot name. This name cannot be same as any pod name (e.g., new-fep-sts-01) in the cluster. Otherwise, the slot will not be created.
spec.fep.replicationSlots.type	logical	Must be 'logical' for logical replication
spec.fep.replicationSlots.database	postgres	Specify the database name for logical replication
spec.fep.replicationSlots.plugin	pgoutput	FEP supports 'pgoutput' by default.
spec.fep.usePodName		Optional Setting this key to true will make internal POD communication, both Patroni and Postgres to use hostname,

Field	Default	Details
		instead of IP address. This is important for TLS as the hostname of the POD is predictable and can be used to create Server Certificate, whereas IP address is unpredictable and cannot be used to create Certificate. There is no negative effect setting this key to true even if TLS (i.e. Server Certificate) is not used.
spec.fep.patroni.tls.certificateName	(created by user)	Optional This points to Kubernetes TLS secret that contains the certificate for Patroni. The certificate itself is stored in the key tls.crt. This field is optional. When this key is set, the Operator will ignore the value in systemCertificates
spec.fep.patroni.tls.caName	(created by user)	Optional This points to Kubernetes configmap that contains additional CA for Patroni to verify client. The CA is stored in the key ca.crt. This field is optional.
spec.fep.postgres.tls.certificateName	(created by user)	Optional This points to Kubernetes TLS secret that contains the certificate for Postgres. The certificate itself is stored in the key tls.crt. This field is optional. When this key is set, Operator will ignore the value in systemCertificates
spec.fep.postgres.tls.caName	(created by user)	Optional This points to Kubernetes configmap that contains additional CA for Postgres to verify client. The CA is stored in the key ca.crt. This field is optional.
spec.fep.postgres.tls.privateKeyPassword	(created by user)	Optional This points to Kubernetes secret that contains the password for the above private key. This field is optional.
spec.fep.pgAuditLog.auditLogPath		Use this value for log_directory in pgaudit.conf If pgAuditLog.auditLogPath is not defined: use '/database/log/audit' or '/database/userdata/data/log' when log volume is not defined .
spec.fep.pgAuditLog.schedules		Schedule to upload auditlog
spec.fep.pgAuditLog.schedules.upload		Upload schedule in crontab format
spec.fep.pgAuditLog.endpoint.protocol	http	Optional Default: http Supported values:

Field	Default	Details
		<ul style="list-style-type: none"> - 'http' - 's3' - 'blob'
spec.fep.pgAuditLog.endpoint.url		Webserver URL to upload the auditlog files
spec.fep.pgAuditLog.endpoint.customCertificateName		Optional Secret that contains the certificate to setup communication with Web server
spec.fep.pgAuditLog.endpoint.insecure	false	Optional equivalent to curl -insecure option
spec.fep.pgAuditLog.endpoint.authentication		<p>Optional</p> <p>This item is the secret name for endpoint authentication.</p> <p>The end user needs to provide this secret to use upload feature.</p> <p>This secret is used for authentication of each protocol accordingly.</p> <p>Refer to "1.2.16.1 Details of pgAuditLog.endpoint.authentication" for details.</p> <p>If this is not specified, a default secret <cluster-name>-pgauditlog-auth will be created.</p>
spec.fep.pgAuditLog.endpoint.fileUploadParameter	file	Optional The file upload parameter defined by the web server
spec.fep.pgAuditLog.endpoint.azureBlobName		<p>Only take effect when protocol is 'blob'</p> <p>Optional</p> <p>The blob name of pgaudit log file.</p> <p>Default: [cluster name]-sts-[pod index]-pgauditlog.zip</p>
spec.fep.pgAuditLog.endpoint.azureContainerName		<p>Required with protocol is 'blob'</p> <p>This item is the container name of the Azure Storage account</p>
spec.fep.pgAuditLog.config		<p>Optional</p> <p>Default: none</p> <p>This item requires a ConfigMap with this name to exist in the same namespace of the FEPCluster.</p> <p>The ConfigMap will be used as pgAudit config file.</p> <p>The ConfigMap need to have a key 'pgaudit.conf'.</p>
spec.fep.pgAuditLog.enable		<p>Optional</p> <p>Default: false</p> <p>When set to 'true', the pgaudit extension is enabled automatically.</p>
spec.fep.pgBadger.schedules.create		The 'create' schedule to create report and upload it to endpoint

Field	Default	Details
spec.fep.pgBadger.schedules.cleanup		The 'cleanup' schedule to delete the report left in container
spec.fep.pgBadger.options.incremental	false	Default: false; When set to true: create incremental report in pgbadger
spec.fep.pgBadger.endpoint.authentication		a secret to contain authentication info to access endpoint support basic auth only
spec.fep.pgBadger.endpoint.customCertificateName		Client certificate reference in customCertificate CR
spec.fep.pgBadger.endpoint.fileUploadParameter	file	The file upload parameter defined by the web server
spec.fep.pgBadger.endpoint.insecure	false	equivalent to curl -insecure option
spec.fep.pgBadger.endpoint.url		Web server url to upload the report file
spec.ldap2pg.enable	true	Setting this to "true" will enable ldap2pg to execute periodically according to schedule defined. Setting this to "false" will remove the cronjob that execute the ldap2pg.
spec.ldap.caConfigMapRef		If LDAP server certificate is signed by a private CA, this key should point to a configmap that has the chain of certificates that ldap2pg and FEP should trust. Operator expects the key name in the configmap be ca.crt.
spec.ldap.ldapconfSecretRef		Name of secret that contains the ldap.conf When spec.ldap is defined but spec.ldap.ldapconfSecretRef is not defined, operator will create a default secret <fep-cluster>-ldapconf. Operator expects the key name in the secret be ldap.conf.
spec.ldap2pg.ldap2pgyamlConfigMapRef		Name of configmap that contains the ldap2pg.yml When spec.ldap2pg is defined but spec.ldap2pg.ldap2pgyamlConfigMapRef is not defined, Operator will create a default configmap <fep-cluster>-ldap2pgyaml. FEP Operator expects the key name in the configmap be ldap2pg.yml.
spec.ldap2pg.mode	check	Whether ldap2pg should run in "check" mode or "real" mode. If not defined, ldap2pg will run in check mode.

Field	Default	Details
spec.ldap2pg.schedule		<p>Schedule to execute ldap2pg in a crontab format.</p> <p>If defined, Operator will create a cronjob using fep-cronjob container and remotely execute ldap2pg on fep-patroni container on a regular basis.</p> <p>If the schedule is not provided, Operator will set the schedule to 5/* * * *.</p>
spec.ldap2pg.skipPrivileges	false	<p>Options</p> <p>Configure synchronization of role attributes and permissions between ldap2pg and FEPCluster.</p> <p>Specify false if you want to synchronize role attributes with permissions, or true if you do not.</p> <p>If true, the behavior is the same as the --skip-privileges (-P) option of the ldap2pg command.</p>
spec.fep.feputils.image	<omitted>	<p>FEPUtills container image to use, quay.io/fujitsu/fujitsu-enterprise-postgres-17-utils:ubi9-17-1.0</p> <p>Optional.</p> <p>Omitted by default. In this case, the image URL is obtained from the operator container environment.</p> <p>If you specify an image, the operator will use that image to deploy the Utils container.</p> <p>When fepChildCrVal.storage.autoresize.enable is true, use this image to expand the pvc-auto-resize container of the fep-tuning Pod.</p>
spec.fep.fepcronjob.image	<omitted>	<p>FEPCronjob container image to use, quay.io/fujitsu/fujitsu-enterprise-postgres-cronjob:ubi9-17-1.0</p> <p>Optional.</p> <p>Omitted by default. In this case, the image URL is obtained from the operator container environment.</p> <p>If you specify an image, the operator will use that image to deploy the Cronjob container.</p>
spec.fep.autoTuning.prometheus.prometheusUrl		<p>Required if fepChildCrVal.storage.autoresize.enable is true.</p> <p>Specifies the URL of the Prometheus for which you want to retrieve metrics.</p>

Field	Default	Details
spec.fep.autoTuning.prometheus.authSecret		Optional Basic authentication secret that provides the user name and encrypted password
spec.fep.autoTuning.prometheus.authSecret.secretName		Username and password, or the name of the secret that contains the token
spec.fep.autoTuning.prometheus.authSecret.userKey		Key of the Secret given the user name
spec.fep.autoTuning.prometheus.authSecret.passwordKey		Key of the Secret with the password specified
spec.fep.autoTuning.prometheus.authSecret.tokenKey		Key of the Secret given the token
spec.fep.autoTuning.prometheus.authSecret.proxyKey		Key of the Secret specified by the proxy
spec.fep.autoTuning.prometheus.tls.certificateName		Refers to the Kubernetes TLS secret that contains the certificate and private key. Prometheus uses this for certificate authentication. The certificate and private key itself are stored in the tls.crt and tls.key keys.
spec.fep.autoTuning.prometheus.tls.caName		Refers to the Kubernetes ConfigMap containing the additional CA that the client uses to verify the server certificate. The CA is stored in the ca.crt key.
spec.fep.autoTuning.prometheus.maxRetry		Specifies the maximum number of retries when a query to Prometheus fails. If not specified, a maximum of 60 retries are attempted.
spec.fep.velero.enable	false	Optional Specifies whether the Velero DR feature is used (true) or not (false). This is omitted by default. In this case, the Velero DR feature is not available.
spec.fep.velero.labels		Optional If the Velero DR feature is used, specify the label to be given to the resource to be backed up by Velero. You can specify multiple labels. If omitted, backup-group: fep-backup is given.
spec.fep.velero.backup		Specifies the object storage information that stores the backup data and archive wal for FEPCluster to be built in a DR environment.

Field	Default	Details
		Otherwise, FEPCluster built in a DR environment will fail to back up to object storage.
spec.fep.velero.backup.pgbackrestParams		<p>" " When nothing is specified, and the parameter set in pgbackrest.conf is described from the line below. (Descriptions vary depending on the provider used)</p> <p>If you use the same object storage as in production, specify a different object storage path (repo*-path) than fepChildCrVal.backup.pgbackrestParams.</p> <p>If you specify the same object storage path, you will receive an event notification.</p>
spec.fep.velero.backup.pgbackrestKeyParams		<p>Optional</p> <p>" " is fixed, and the following line describes the parameters to be set in pgbackrest.conf. The value described by this parameter is masked with *****.</p>
spec.fep.velero.backup.caName		<p>Optional</p> <p>Set to use a CA file other than the system default. Specifies the name of the Configmap you created.</p> <p>If you use a different CA file than the production environment, give the CA file a different name and set it here. It must also be deployed in the DR environment.</p>
spec.fep.velero.backup.repoKeySecretName		<p>Optional</p> <p>Specifies the name of the Kubernetes Secret generated from the object storage key file. Specify in array format.</p> <p>If you use a different secret from the production environment, give the secret a different name and set it here. It must also be deployed in the DR environment.</p>
spec.fep.velero.restore.image.image		<p>Optional</p> <p>Image of the container to perform the restore. It is omitted by default. In this case, the URL for image is obtained from the operator container environment.</p>
spec.fep.velero.restore.image.pullPolicy	IfNotPresent	<p>Specifies the pull policy for the image.</p> <ul style="list-style-type: none"> - Always - IfNotPresent

Field	Default	Details
spec.fep.velero.restore.mcSpec.limit	cpu: 200m memory: 300Mi	Specifies the maximum number of resources to allocate to the restore execution container.
spec.fep.velero.restore.mcSpec.request	cpu: 100m memory: 200Mi	Specifies the lower number of resources to allocate to the restore execution container.
spec.fep.velero.restore.restoreTargetRepo	1	Specifies the backup data used to restore FEPCluster to the DR environment and the object storage information where the archive wal is stored. This is the number of the repo in fepChildCrVal.backup.pgbackrestParams.
spec.fep.fixedStats.scheduleN		Schedule a locked statistics. Specify an integer for N.
spec.fep.fixedStats.scheduleN.fixSchedule		Time to start locked statistics. schedule in cron format The date and time are in UTC time.
spec.fep.fixedStats.scheduleN.unfixSchedule		Options Time to unpin locked statistics. Returns to regular statistics. If not specified, it is not cleared. schedule in cron format The date and time are in UTC time.
spec.fep.fixedStats.scheduleN.targetDb		Specify the database for which you want to locked statistics.
spec.fep.fixedStats.scheduleN.fixedObject		Options If the scope to be locked is smaller than the database, specify that object. Specify schema.table.column. The minimum range is the column and the maximum range is the schema.
spec.fep.fixedStats.endpoint.protocol		Specify the object storage vendor where statistics are stored. s3, blob, gcs can be specified. Also, if you want to directly import a file on the container, specify local.
spec.fep.fixedStats.endpoint.authentication		Specify this option if the protocol is s3, blob, gcs. Authentication for accessing object storage Specify a secret file that contains confidential information.
spec.fep.fixedStats.scheduleN.url		Specify this option if the protocol is s3, gcs.

Field	Default	Details
		Specify the URL from which to download the statistics binary file.
spec.fep.fixedStats.scheduleN.azureBlobName		Specify this if the protocol is a blob. Name of the blob containing the statistics binary file.
spec.fep.fixedStats.scheduleN.azureContainerName		Specify this if the protocol is a blob. This item is the container name of the Azure storage account.
spec.fep.fixedStats.scheduleN.file		Specify this if the protocol is a local. Specify the name of the file deployed on the fep-patropni container.
spec.fep.fixedStats.scheduleN.update	false	Set this setting to true if you want to download statistics to be locked from object storage.
spec.fep.fixedStats.image		The CronJob image to use. If not specified, the operator uses the latest version supported by the operator.
spec.fep.fixedStats.pullPolicy	IfNotPresent	
spec.fep.fixedStats.scheduleN.enable		Options You can specify whether scheduled statistics are to be locked or released. Executed if omitted or true, not if false.
spec.fep.freezingTuples.enable	false	Options When true is specified, enables periodic execution of freezing operations.
spec.fep.freezingTuples.scheduleN		Options Specifies the schedule for the freeze operation. You can specify multiple names in dictionary format. Specify an integer for N.
spec.fep.freezingTuples.scheduleN.start	0 1 * * *	Specifies the date and time for starting processing in cron format. If omitted, the default values are applied.
spec.fep.freezingTuples.scheduleN.executionTime	3600	Options Specified value: string Units: s, m, h,d Specifies the duration of the processing. If no unit is specified, s is assumed. If omitted, the default values are applied.
spec.fep.backupStats.enable	false	You can set statistics to be backed up. If set to false, no backup is performed. If set to true, backup is performed.

Field	Default	Details
		<p>If <code>spec.fep.backupStats.enable</code> is not defined as false when FEPCluster is first built, it is set to true.</p> <p>If <code>spec.fep.backupStats.schedule1</code> is not defined when FEPCluster is first built, a backup with default settings is defined in the FEPCluster custom resource.</p>
<code>spec.fep.backupStats.image</code>		The CronJob image to use. If not specified, the operator uses the latest version supported by the operator.
<code>spec.fep.backupStats.pullPolicy</code>	IfNotPresent	
<code>spec.fep.backupStats.scheduleN</code>		Schedule a backup of the statistics. Specify an integer for N.
<code>spec.fep.backupStats.scheduleN.backupSchedule</code>		Time to start taking statistics backups. schedule in cron format The date and time are in UTC time.
<code>spec.fep.backupStats.scheduleN.targetDb</code>		Optional Specify the database to be backed up. If omitted, runs for all databases.
<code>spec.fep.backupStats.scheduleN.fixedObject</code>		Optional If the backup target is less than the database, specify the object. Specify <code>schema.table.column</code> . The minimum range is the column and the maximum range is the schema.
<code>spec.fep.backupStats.scheduleN.comment</code>		Optional Comments that can be defined when backing up statistics. If omitted, <code>FepFixedStatsBackup:scheduleN</code> is set. Do not use the following phrases in comments. <code>FepFixedStats</code>
<code>spec.fep.backupStats.scheduleN.retention</code>		Options At the same time as a scheduled backup, you can delete backups that are stored in the target database for a specified number of days or earlier. Specify an integer. If omitted, no deletion is performed.
<code>spec.fep.backupStats.scheduleN.enable</code>		Options You can specify whether scheduled statistics are to be locked or released. Executed if omitted or true, not if false.

Field	Default	Details
spec.fepChildCrVal.customCertificates		Optional An array of elements for defining a certificate. It consists of the following parameters: <ul style="list-style-type: none"> - username - certificateName - caName Used to setup SSL connection between publisher and subscriber clusters for logical replication.
spec.fepChildCrVal.customCertificates.userName		Optional This should be the username of the publisher database. When this parameter is specified, an empty folder is created under FEP Server Container- /tmp/custom_certs/<username>. The custom certificates are mounted in this empty folder. However, if this parameter is not specified, the section is ignored and folder is not created; hence the certificates are not mounted without it.
spec.fepChildCrVal.customCertificates.certificateName	(created by user)	Optional This points to Kubernetes TLS secret that contains the custom certificate. The certificate itself is stored in the key tls.crt.
spec.fepChildCrVal.customCertificates.caName	(created by user)	Optional This points to Kubernetes configmap that contains CA certificate to verify server. The CA is stored in the key ca.crt.
spec.fepChildCrVal.backup		Optional This section is defined to enable febackup sidecar for cluster backup feature.
spec.fepChildCrVal.backup.image.image	<omitted>	FEP backup container image to be used quay.io/fujitsu/fujitsu-enterprise-postgres-17-backup:ubi9-17-1.0 It is optional. Image line is omitted by default. In such a case, it will pick up URL of image from operator container environment. If you specify the image, Operator will take that image to deploy backup container
spec.fepChildCrVal.backup.image.pullPolicy	IfNotPresent	

Field	Default	Details
spec.fepChildCrVal.backup.mcSpec.limits	cpu: 0.2 memory: "300Mi"	
spec.fepChildCrVal.backup.mcSpec.requests	cpu: 0.1 memory: "200Mi"	
sepc.fepChildCrVal.backup.type		Optional Specifiable value: local Apply the settings for taking a backup to the PV to the custom resource. Can only be set the first time the FEPCluster custom resource is applied. You cannot add or change settings after applying.
spec.fepChildCrVal.backup.pgbackrestParams	(If sepc.fepChildCrVal.backup.type is local) [global] repo1-retention-full=7 repo1-retention-full-type=time log-path=/database/log/backup	Specifies the object storage information that stores the backup data and archive wal. " <code> </code> " When nothing is specified, and the parameter set in pgbackrest.conf is described from the line below. The value described by this parameter is masked with *****. (Descriptions vary depending on the provider used)
spec.fepChildCrVal.backup.pgbackrestKeyParams		Optional " <code> </code> " is fixed, and the following line describes the parameters to be set in pgbackrest.conf. The value described by this parameter is masked with *****.
spec.fepChildCrVal.backup.caName		Optional Set to use a CA file other than the system default. Specifies the name of the Configmap you created.
spec.fepChildCrVal.backup.repoKeySecretName		Optional Specifies the name of the Kubernetes Secret generated from the object storage key file. Specify in array format.
spec.fepChildCrVal.backup.schedule.num	0 (If sepc.fepChildCrVal.backup.type is local) 2	Number of schedules to set The maximum number of backup schedules is 5.
spec.fepChildCrVal.backup.schedule.N.schedule	(If sepc.fepChildCrVal.backup.type is local) schedule1: schedule: "15 0 * * 0"	Backup schedule in cron format. The date and time is UTC time.

Field	Default	Details
	<pre>schedule2: schedule: "15 0 * * 1-6"</pre>	
spec.fepChildCrVal.backup.scheduleN.type	<pre>(If sepc.fepChildCrVal.backup.type is local) schedule1: type: full schedule2: type: incr</pre>	<p>full: Perform a full backup (Back up the contents of the database cluster).</p> <p>incr – Perform an incremental backup (Back up only the database cluster files that were changed to the last backup migration).</p>
spec.fepChildCrVal.backup.scheduleN.repo	1	<p>Optional</p> <p>Gets a backup in the specified repository.</p> <p>The range is 1 to 256.</p>
spec.fepChildCrVal.customPgAudit	<pre>[output] logger = 'auditlog' log_directory = '/database/log/audit' log_truncate_on_rotation = on log_filename = 'pgaudit-%a.log' log_rotation_age = 1d log_rotation_size = 0 [rule]</pre>	PgAudit file content
spec.fepChildCrVal.customPgHba	<pre># define pg_hba custom rules here to be merged with default rules. # TYPE DATABASE USER ADDRESS METHOD</pre>	Entries to be inserted into pg_hba.conf
spec.fepChildCrVal.customPgParams	<pre># define custom postgresql.conf parameters below to override defaults. # Current values are as per default FEP deployment shared_preload_libraries='pgx_datamasking,pg_prewarm,pg_stat_statements,fsep_operator_security' session_preload_libraries='pg_prewarm' max_prepared_transactions = 100 max_worker_processes = 30 max_connections = 100 work_mem = 1MB maintenance_work_mem = 12MB shared_buffers = 128MB effective_cache_size = 384MB checkpoint_completion_target = 0.8 # tcp parameters tcp_keepalives_idle = 30 tcp_keepalives_interval = 10</pre>	<p>Postgres configuration in postgresql.conf</p> <p>If the FEP server container utilizes images with a FEPBaseVersion less than 15, exclude fsep_operator_security from the configuration.</p> <p>If spec.fep.databaseSize is defined, the default value will be changed as shown below.</p> <p>shared_buffers = 30% of spec.fep.mcSpec.limits.memory</p> <p>work_mem = 30% of spec.fep.mcSpec.limits.memory / max_connections / 2</p> <p>effective_cache_size = 75% of spec.fep.mcSpec.limits.memory</p> <p>maintenance_work_mem = 10% of spec.fep.mcSpec.limits.memory / (1 + autovacuum_max_workers)</p>

Field	Default	Details
	<pre> tcp_keepalives_count = 3 # logging parameters in default fep installation # if log volume is not defined, log_directory should be # changed to '/database/userdata/data/log' log_directory = '/database/log' log_filename = 'logfile-%a.log' log_file_mode = 0600 log_truncate_on_rotation = on log_rotation_age = 1d log_rotation_size = 0 log_checkpoints = on log_line_prefix = '%e %t [%p]: [%l-1] user=%u,db=%d,app=%a,client=%h' log_lock_waits = on log_autovacuum_min_duration = 60s logging_collector = on pgaudit.config_file='/opt/app-root/src/ pgaudit-cfg/pgaudit.conf' log_replication_commands = on log_min_messages = WARNING log_destination = stderr # wal_archive parameters in default fep installation archive_mode = on archive_command = 'pgbackrest -- stanza=backupstanza --config=/database/ userdata/pgbackrest.conf archive-push %p' wal_level = replica max_wal_senders = 12 wal_keep_segments = 64 track_activities = on track_counts = on password_encryption = 'md5' </pre>	
spec.fepChildCrVal.storage.dataVol		Mandatory volume
spec.fepChildCrVal.storage.dataVol.size	2Gi (**)	Size of data volume. Data volume must be specified
spec.fepChildCrVal.storage.dataVol.storageClass	<omitted> (*)	StorageClass for data volume:

Field	Default	Details
		When this line is omitted, the PV created will use default storage class in the Kubernetes cluster
spec.fepChildCrVal.storage.dataVol.accessModes	<omitted> (*)	accessModes for data volume: Specified as an array of accessModes e.g. [ReadWriteMany] If omitted, it will be treated as [ReadWriteOnce]
spec.fepChildCrVal.storage.walVol		Mandatory volume
spec.fepChildCrVal.storage.walVol.size	1200Mi (**) (If spec.fepChildCrVal.storage.dataSize is defined) 5Gi	Size of WAL volume. WAL volume must be specified
spec.fepChildCrVal.storage.walVol.storageClass	<omitted> (*)	StorageClass for WAL volume: When this line is omitted, the PV created will use default storage class in the Kubernetes cluster
spec.fepChildCrVal.storage.walVol.accessModes	<omitted> (*)	accessModes for WAL volume: Specified as an array of accessModes e.g. [ReadWriteMany] If omitted, it will be treated as [ReadWriteOnce]
spec.fepChildCrVal.storage.tablespaceVol		Optional volume
spec.fepChildCrVal.storage.tablespaceVol.size	512Mi (**) (If spec.fepChildCrVal.storage.dataSize is defined) The value specified in spec.fepChildCrVal.storage.dataSize.	Size of tablespace volume. This volume is optional and can be omitted
spec.fepChildCrVal.storage.tablespaceVol.storageClass	<omitted> (*)	StorageClass for tablespace volume: When this line is omitted, the PV created will use default storage class in the Kubernetes cluster
spec.fepChildCrVal.storage.tablespaceVol.accessModes	<omitted> (*)	accessModes for tablespace volume: Specified as an array of accessModes e.g. [ReadWriteMany] If omitted, it will be treated as [ReadWriteOnce]
spec.fepChildCrVal.storage.archiveWalVol		Mandatory if backup section is defined. Optional otherwise

Field	Default	Details
spec.fepChildCrVal.storage.archiveWalVol.size	1Gi (**) (If spec.fepChildCrVal.storage.dataSize is defined and sepc.fepChildCrVal.backup.type is local) (spec.fepChildCrVal.storage.dataSize/10)*14	Size of archivewal volume. This volume is optional and can be omitted
spec.fepChildCrVal.storage.archiveWalVol.storageClass	<omitted> (*)	StorageClass for Archived WAL volume: When this line is omitted, the PV created will use default storage class in the Kubernetes cluster When the number of instance is more than 1 and backup is not done on S3, both archivewalVol and backupVol must be hosted on Shared storage such as NFS with respective storageClass
spec.fepChildCrVal.storage.archiveWalVol.accessModes	<omitted> (*)	accessModes for Archived WAL volume: Specified as an array of accessModes e.g. [ReadWriteMany] If omitted, it will be treated as [ReadWriteOnce] When the number of instance is more than 1 and backup is not done on S3, both archivewalVol and backupVol must be hosted on Shared storage such as NFS with accessMode set to [ReadWriteMany]
spec.fepChildCrVal.storage.logVol		Optional volume
spec.fepChildCrVal.storage.logVol.size	1Gi (**) (If spec.fepChildCrVal.storage.dataSize is defined) 5Gi	Size of log volume. This volume is optional and can be omitted
spec.fepChildCrVal.storage.logVol.storageClass	<omitted> (*)	StorageClass for log volume: When this line is omitted, the PV created will use default storage class in the Kubernetes cluster
spec.fepChildCrVal.storage.logVol.accessModes	<omitted> (*)	accessModes for log volume: Specified as an array of accessModes e.g. [ReadWriteMany] If omitted, it will be treated as [ReadWriteOnce]

Field	Default	Details
spec.fepChildCrVal.storage.backupVol		Mandatory if backup section is defined. Optional otherwise
spec.fepChildCrVal.storage.backupVol.size	2Gi (**) (If spec.fepChildCrVal.storage.dataSize is defined and sepc.fepChildCrVal.backup.type is local) spec.fepChildCrVal.storage.dataSize*14	Size of backup volume. This volume is optional and can be omitted
spec.fepChildCrVal.storage.backupVol.storageClass	<omitted> (*)	StorageClass for backup volume: When this line is omitted, the PV created will use default storage class in the Kubernetes cluster When the number of instance is more than 1 and backup is not done on S3, both archivalVol and backupVol must be hosted on Shared storage such as NFS with respective storageClass
spec.fepChildCrVal.storage.backupVol.accessModes	<omitted> (*)	accessModes for backup volume: Specified as an array of accessModes e.g. [ReadWriteMany] If omitted, it will be treated as [ReadWriteOnce] When the number of instance is more than 1 and backup is not done on S3, both archivalVol and backupVol must be hosted on Shared storage such as NFS with accessMode set to [ReadWriteMany]
sepc.fepChildCrVal.storage.dataSize		Specify the amount of data at the data storage destination. The operator defines the size of dataVol, walVol, logVol, tablespaceVol, archivalVol, and backupVol based on the specified value. If you specify individual volumes, specify the size of each volume definition.
sepc.fepChildCrVal.storage.accessModes		Specify the accessModes for each volume if you want to specify them in a batch. If you want to set them individually, specify the accessModes for each volume definition.
sepc.fepChildCrVal.storage.storageClass		Specify the storageClass for each volume if you want to specify them in a batch. If you want to set them individually,

Field	Default	Details
		specify the storageClass for each volume definition.
spec.fepChildCrVal.storage.autoresize		
spec.fepChildCrVal.storage.autoresize.enable	false	Optional Specified value: boolean true to enable auto-extension for PVCs.
spec.fepChildCrVal.storage.autoresize.mcSpec.limits	cpu: 50m memory: 60Mi	Optional Specifies the resource limit that can be allocated to pvc-auto-resize container.
spec.fepChildCrVal.storage.autoresize.mcSpec.requests	cpu: 10m memory: 5Mi	Optional Specifies the resources to assign that can be allocated to pvc-auto-resize container.
spec.fepChildCrVal.storage.autoresize.interval	30	Optional Units: s Specifies the interval between metric checks. If 0 or less is specified, the PVC is not extended.
spec.fepChildCrVal.storage.autoresize.threshold	80	Optional Specified value: integer Unit:% Specifies the storage utilization threshold. Extends the PVC when this value is exceeded. When 0 is specified, storage utilization is not checked. The xxxVol.threshold applies to all storage that is not defined.
spec.fepChildCrVal.storage.autoresize.increaseType	percent	Optional Specified value: percent, size Specifies how the PVC extension is estimated when the threshold is exceeded. When percent is specified Expands the PVC by the specified percentage of its original capacity. If size is specified Extends the PVC by the specified amount (Gi). Applies to all storage where xxxVol.increaseType is not defined.

Field	Default	Details
spec.fepChildCrVal.storage.autoresize.increase	25	<p>Optional</p> <p>Specified value: integer</p> <p>Units:% or Gi</p> <p>Specifies the extension amount for the PVC.</p> <p>The units depend on the value specified for increaseType.</p> <p>If a value less than or equal to 0 is specified, no extension is performed.</p> <p>This applies to all storage where xxxVol.increase is not defined.</p>
spec.fepChildCrVal.storage.autoresize.storageLimit		<p>Optional</p> <p>Specified value: integer</p> <p>Units: Gi</p> <p>Specifies the maximum value by which the PVC can be extended.</p> <p>If not specified, the extension is unrestricted. If you do not specify this value, we recommend that you verify that the storage class being used has a namespace quota.</p> <p>Do not extend the PVC when less than or equal to disk space is specified.</p> <p>Applies to all storage where xxxVol.storageLimit is not defined.</p>
spec.fepChildCrVal.storage.xxxVol		xxx is the contents of data, wal, log, tablespace, archival, backup
spec.fepChildCrVal.storage.xxxVol.threshold		<p>Optional</p> <p>Specified value: integer</p> <p>Unit:%</p> <p>Specifies the storage utilization threshold.</p> <p>Extends the PVC when this value is exceeded.</p> <p>When 0 is specified, storage utilization is not checked.</p> <p>If not specified, it follows the value specified in autoresize.threshold.</p>
spec.fepChildCrVal.storage.xxxVol.increaseType		<p>Optional</p> <p>Specified value: percent, size</p> <p>Specifies how the PVC extension is estimated when the threshold is exceeded.</p> <p>When percent is specified</p>

Field	Default	Details
		<p>Expands the PVC by the specified percentage of its original capacity.</p> <p>If size is specified</p> <p>Extends the PVC by the specified amount (Gi).</p> <p>If not specified, the value specified by <code>autoresize.increaseType</code>.</p>
<code>spec.fepChildCrVal.storage.xxxVol.increase</code>		<p>Optional</p> <p>Specified value: integer</p> <p>Units: % or Gi</p> <p>Specifies the extension amount for the PVC.</p> <p>The units depend on the value specified for <code>increaseType</code>.</p> <p>If not specified, the value specified by <code>autoresize.increase</code>.</p>
<code>spec.fepChildCrVal.storage.xxxVol.storageLimit</code>		<p>Optional</p> <p>Specified value: integer</p> <p>Units: Gi</p> <p>Specifies the maximum capacity by which the PVC can be extended.</p> <p>Do not expand if the specification is less than or equal to the disk capacity.</p> <p>If not specified, it follows the value specified by <code>autoresize.storageLimit</code>.</p>
<code>spec.fepChildCrVal.sysUsers.pgAdminPassword</code>	<omitted>	<p>Password for user "postgres"</p> <p>Available character types</p> <p>Alphanumeric characters (A-Z, a-z), numbers (0-9), symbols (~! @ # \$% ^ & * () - = < > , . ? ; : / +)</p> <p>If this parameter is omitted, the Operator automatically generates a password.</p> <p>If the FEP server container uses an image with a <code>FEPBaseVersion</code> less than 15, be sure to specify this parameter.</p>
<code>spec.fepChildCrVal.sysUsers.pgdb</code>	<code>mydb</code> (*)	<p>Database to be created during provisioning</p> <p>Available character types</p> <p>Alphanumeric characters (A-Z, a-z), numbers (0-9), and underscores (_)</p> <p>However, you cannot start with a number.</p> <p>Upper case letters are treated as lower case letters.</p>

Field	Default	Details
		<p>Maximum string length</p> <p>63 characters</p>
spec.fepChildCrVal.sysUsers.pguser	mydbuser (*)	<p>Database user to be created during provisioning</p> <p>Available character types</p> <p>Alphanumeric characters (A-Z, a-z), numbers (0 -9), and underscores (_)</p> <p>However, you cannot start with a number.</p> <p>Upper case letters are treated as lower case letters.</p> <p>Maximum string length</p> <p>63 characters</p> <p>This database user is the owner of the database defined in "spec.fepChildCrVal.sysUsers.pgdb" and has the role of database administrator.</p> <p>This user has the following privileges: . NOSUPERUSER, NOREPLICATION, NOBYPASSRLS, CREATEDB, INHERIT, LOGIN, CREATEROLE (NOCREATEROLE when spec.fepChildCrVal.sysUsers.pgSecurityUser is defined)</p> <p>They also belong to the following roles: . pg_monitor, pg_signal_backend</p>
spec.fepChildCrVal.sysUsers.pgpassword	mydbpassword	<p>Password for database user pguser</p> <p>Available character types</p> <p>Alphanumeric characters (A-Z, a-z), numbers (0 -9), symbols (~! @ # \$% ^ & * () - = < > , . ? ; : / +)</p>
spec.fepChildCrVal.sysUsers.pgrepluser	repluser (*)	<p>Database user for replication</p> <p>Available character types</p> <p>Alphanumeric characters (A-Z, a-z), numbers (0 -9), and underscores (_)</p> <p>However, you cannot start with a number.</p> <p>Maximum string length</p> <p>63 characters</p>
spec.fepChildCrVal.sysUsers.pgreplpassword	repluserpwd	Alphanumeric characters
spec.fepChildCrVal.sysUsers.tdepassphrase	tde-passphrase	TDE keystore passphrase

Field	Default	Details
spec.fepChildCrVal.sysUsers.pgRewindUser	rewind_user	<p>Database user for Rewind</p> <p>Available character types</p> <p>Alphanumeric characters (A-Z, a-z), numbers (0 -9), and underscores (_)</p> <p>However, you cannot start with a number.</p> <p>Maximum string length</p> <p>63 characters</p>
spec.fepChildCrVal.sysUsers.pgRewindUserPassword	rewind_password	<p>Password for database user rewinduser</p> <p>Available character types</p> <p>Alphanumeric characters (A-Z, a-z), numbers (0 -9), symbols (~! @ # \$% ^ & * () - = < > . , ? ; : /+)</p>
spec.fepChildCrVal.sysUsers.pgMetricsUser		<p>Optional</p> <p>user for FEPEXporter connection. Can be defined afterwards</p> <p>Available character types</p> <p>Alphanumeric characters (A-Z, a-z), numbers (0 -9), and underscores (_)</p> <p>However, you cannot start with a number.</p> <p>Upper case letters are treated as lower case letters.</p> <p>Maximum string length</p> <p>63 characters</p>
spec.fepChildCrVal.sysUsers.pgMetricsUserPassword		<p>Optional</p> <p>Password for metrics user. Can be defined afterwards</p> <p>Available character types</p> <p>Alphanumeric characters (A-Z, a-z), numbers (0 -9), symbols (~! @ # \$% ^ & * () - = < > . , ? ; : /+)</p>
spec.fepChildCrVal.sysUsers.pgSecurityUser		<p>Options</p> <p>Username of the security administrator user. Can be defined later.</p> <p>This parameter is optional, but cannot be changed or deleted after it has been defined.</p> <p>Available character types</p> <p>Alphanumeric characters (A-Z, a-z), numbers (0 -9), and underscores (_)</p> <p>However, you cannot start with a number.</p>

Field	Default	Details
		<p>Upper case letters are treated as lower case letters.</p> <p>Maximum string length 63 characters</p>
spec.fepChildCrVal.sysUsers.pgSecurityPassword		<p>Options</p> <p>Defines the password for the sensitive administrator user.</p> <p>This parameter is optional but required when "pgSsecurityUser" is defined.</p> <p>Available character types</p> <p>Alphanumeric characters (A-Z, a-z), numbers (0 -9), symbols (~! @ # \$% ^ & * () - = < > , . ? ; : / +)</p>
spec.fepChildCrVal.sysUsers.passwordValid		<p>Options</p> <p>Manage password expiration for database users.</p> <p>Sets the expiration date for database user passwords defined in the FEPCluster custom resource below.</p> <ul style="list-style-type: none"> - pgpassword, pgSecurityPassword <p>In addition, if shared_preload_libraries in customPgParams is set to "fsep_operator_security" and the "CREATE ROLE" or "ALTER ROLE" command is used to update the password of a database user with login privileges and the expiration time is not defined or is longer than the specified expiration time, the operation will fail.</p> <p>Updates the password expiration date for database users with login privileges that have not expired when the specified expiration date is updated.</p>
spec.fepChildCrVal.sysUsers.passwordValid.days		<p>Options</p> <p>Specifies the number of days the database role is valid.</p> <p>Specify an integer value greater than or equal to 0.</p> <p>If any other value is entered, it is treated as 0 (no expiration date is set).</p> <p>The 'days' option is not available when using the Cloud-based Secret Management feature.</p> <p>When you take advantage of the Cloud-based Secret Management feature, the database user password expiration can be managed by a rotation policy</p>

Field	Default	Details
		provided by an external secret store service.
spec.fepChildCrVal.sysUsers.pgAdminTls.certificateName		This points to Kubernetes TLS secret that contains the certificate of Postgres user "postgres". Patroni will use this for certificate authentication. The certificate itself is stored in the key tls.crt. This field is optional.
spec.fepChildCrVal.sysUsers.pgAdminTls.caName		This points to Kubernetes configmap that contains additional CA the client use to verify a server certificate. The CA is stored in the key ca.crt. This field is optional.
spec.fepChildCrVal.sysUsers.pgAdminTls.sslMode	prefer	Specify the type of TLS negotiation with the server. <ul style="list-style-type: none"> - disable - allow - prefer - require - verify-ca - verify-full
spec.fepChildCrVal.sysUsers.pgrepUserTls.certificateName		This points to Kubernetes TLS secret that contains the certificate of Postgres user "repluser". Patroni will use this for certificate authentication. The certificate itself is stored in the key tls.crt. This field is optional.
spec.fepChildCrVal.sysUsers.pgrepUserTls.caName		This points to Kubernetes configmap that contains additional CA the client use to verify a server certificate. The CA is stored in the key ca.crt. This field is optional.
spec.fepChildCrVal.sysUsers.pgrepUserTls.sslMode	prefer	Specify the type of TLS negotiation with the server. <ul style="list-style-type: none"> - disable - allow - prefer - require - verify-ca - verify-full
spec.fepChildCrVal.sysUsers.pgRewindUserTls.certificateName		This points to Kubernetes TLS secret that contains the certificate of Postgres user "rewinduser". Patroni will use this for certificate authentication. The certificate itself is stored in the key tls.crt. This field is optional.

Field	Default	Details
spec.fepChildCrVal.sysUsers.pgRewindUserTls.caName		This points to Kubernetes configmap that contains additional CA the client use to verify a server certificate. The CA is stored in the key ca.crt. This field is optional.
spec.fepChildCrVal.sysUsers.pgRewindUserTls.sslMode	prefer	Specify the type of TLS negotiation with the server. <ul style="list-style-type: none"> - disable - allow - prefer - require - verify-ca - verify-full
spec.fepChildCrVal.sysUsers.pgMetricsUserTls.certificateName		Optional This points to Kubernetes TLS secret that contains the certificate of Postgres user defined by pgMetricsUser. FEPEXporter will use this for certificate authentication. The certificate itself is stored in the key tls.crt.
spec.fepChildCrVal.sysUsers.pgMetricsUserTls.caName		Optional This points to Kubernetes configmap that contains additional CA the client use to verify a server certificate. The CA is stored in the key ca.crt.
spec.fepChildCrVal.sysUsers.pgMetricsUserTls.sslMode	prefer	Optional Specify the type of TLS negotiation when FEPEXporter connects to FEP server. <ul style="list-style-type: none"> - disable - allow - prefer - require - verify-ca - verify-full
spec.fepChildCrVal.sysTde	(*)	Optional If the user selects a file-based TDE, you do not need to define it. Required when implementing TDE with a key management system (KMS).
spec.fepChildCrVal.sysTde.tdeType	(*)	Optional The parameter itself is optional, but required when spec.fepChildCrVal.sysTde is defined. Specify tdek.
spec.fepChildCrVal.sysTde.tdek		Optional Defines the connection information to

Field	Default	Details
		the KMS. Required when tdek is specified for spec.fepChildCrVal.sysTde.tdekType.
spec.fepChildCrVal.sysTde.tdek.targetKmsName		Specify one of the key management system names defined in kmsDefinition[*].name as the name of the key management system to use as the keystore.
spec.fepChildCrVal.sysTde.tdek.targetKeyId		Specifies the key ID (Identifier attribute in KMIP) attached to the encryption key in KMS. When you update this parameter, the Operator automatically updates the master key.
spec.fepChildCrVal.sysTde.tdek.kmsDefinition		Specifies KMS connection information. Specify in array format. You can specify connection information for multiple KMS.
spec.fepChildCrVal.sysTde.tdek.kmsDefinition[*].name	(*)	The name given to the KMS (key management system name) specified in spec.fepChildCrVal.sysTde.tdek.targetKmsName. The KMS name must be a string of no more than 63 characters beginning with a-z, consisting of a-z, numbers (0-9), and underscores. Upper and lower case letters are the same.
spec.fepChildCrVal.sysTde.tdek.kmsDefinition[*].type	(*)	Specifies the type of KMS. You can specify either kmip, awskms, or azurekeyvault.
spec.fepChildCrVal.sysTde.tdek.kmsDefinition[*].address	(*)	Specifies the host name or IP address of the KMIP server.
spec.fepChildCrVal.sysTde.tdek.kmsDefinition[*].port	(*)	Specifies the port of KMIP server.
spec.fepChildCrVal.sysTde.tdek.kmsDefinition[*].authMethod	(*)	Specifies the authentication method in KMIP server. Currently, the only possible value is cert.
spec.fepChildCrVal.sysTde.tdek.kmsDefinition[*].sslpassphrase		Optional Specifies the passphrase of the client certificate private key file when connecting to KMIP server. This can be omitted if no passphrase is set in the private key file.
spec.fepChildCrVal.sysTde.tdek.kmsDefinition[*].cert		Optional Specifies the name of the Secret/ConfigMap containing the certificate file, etc., when cert is specified as authMethod.

Field	Default	Details
spec.fepChildCrVal.sysTde.tdek.kmsDefinition[*].cert.certificateName	(*)	Specifies the TLS Secret name that contains the client certificate and private key for TLS communication with KMIP server.
spec.fepChildCrVal.sysTde.tdek.kmsDefinition[*].cert.caName	(*)	Specifies the ConfigMap name that contains the file name of the SSL Certificate Authority certificate. Used to verify the server certificate of the connection destination.
spec.fepChildCrVal.sysTde.tdek.kmsDefinition[*].profile		Specify a profile that uses AWS KMS. For more information about profile, see the official AWS documentation.
spec.fepChildCrVal.sysTde.tdek.kmsDefinition[*].awsKmsCredentials		Specify a Secret that contains credentials (access key id and secret access key) to AWS KMS.
spec.fepChildCrVal.sysTde.tdek.kmsDefinition[*].awsKmsConfig		Specify a ConfigMap that contains configuration information for the AWS KMS CLI.
spec.fepChildCrVal.sysTde.tdek.kmsDefinition[*].appid		Enter the application ID when using Azure Key Vault. You can get this when you create a service principal.
spec.fepChildCrVal.sysTde.tdek.kmsDefinition[*].tenantid		Specify tenantid when using Azure Key Vault. You can get this when you create a service principal.
spec.fepChildCrVal.sysTde.tdek.kmsDefinition[*].encAlgorithm		Specifies when using Azure Key Vault. See the appendix for the algorithms you can select, refer to "Available Algorithms" in the User's Guide.
spec.fepChildCrVal.sysTde.tdek.kmsDefinition[*].azureKeyVaultClientPassphrase		Used to authenticate to Azure Key Vault. Specifies the secret that contains the client Secret (password).
spec.fepChildCrVal.sysTde.tdek.kmsDefinition[*].azureKeyVaultClientCertificate		Used to authenticate to Azure Key Vault. Specifies the Secret that contains the client certificate.
spec.fepChildCrVal.systemCertificates.key		Use spec.fep.postgres.tls specification instead.
spec.fepChildCrVal.systemCertificates.crt		Use spec.fep.postgres.tls specification instead.
spec.fepChildCrVal.systemCertificates.cacrt		Use spec.fep.postgres.tls specification instead.
spec.fepChildCrVal.autoscale.scaleout.policy	off	Specifies whether to use the automatic scale out feature and the metric to base on. Specify one of the following: <ul style="list-style-type: none"> - cpu_utilization (if based on CPU utilization) - connection_number (if based on number of connections) - off (without automatic scale out)

Field	Default	Details
		If omitted, off is assumed.
spec.fepChildCrVal.autoscale.scaleout.threshold	40	Specifies an integer as the threshold for performing scale out. - When cpu_utilization is specified for policy Specifies the average CPU utilization as a percentage for the threshold. If this option is omitted, 40 (40%) is assumed. - When connection_number is specified for policy Specifies the average value of the number of connections as a threshold. If you omit this option, 40 is assumed.
spec.fepChildCrVal.autoscale.scaleout.metricName	pg_capacity_connection_average	Specify this parameter if policy is connection_number. Ignored if policy is cpu_utilization. The custom metrics server must publish the average number of connections in the FEP cluster under this name. If omitted, pg_capacity_connection_average is assumed.
spec.fepChildCrVal.autoscale.scaleout.stabilizationWindowSeconds	0	This parameter controls the stability of scaling (variation in the number of replicas). Scale out is not performed unless the metric exceeds the threshold for more than the number of seconds specified for this parameter. If omitted, 0 is assumed.
spec.fepChildCrVal.autoscale.limits.maxReplicas	2	Maximum number of replicas (0 to 15) (Value out of range) Do not perform auto scale out
spec.fepChildCrVal.restore		Optional Defines to restore specified backup data stored in object storage.
spec.fepChildCrVal.restore.pgbackrestParams		Optional " " is fixed, and the following line describes the parameters to be set in pgbackrest.conf. Specifies the object storage where the backup data is stored. If you need to use a root certificate other than the default, specify the following: repo1-storage-ca-path =/pgbackrest/storage-certs/filename The CA file is registered in ConfigMap and the ConfigMap name is listed in spec.fepChildCrVal.restore.caName.

Field	Default	Details
spec.fepChildCrVal.restore.pgbackrestKeyParams		Optional " " is fixed, and the following line describes the parameters to be set in pgbackrest.conf. The value described by this parameter is masked with *****. Specify the parameter you want to mask, such as a password.
spec.fepChildCrVal.restore.caName		Optional Set to use a CA file other than the system default. Specifies the name of the ConfigMap created, in list format. The ConfigMap specified is mounted in /pgbackrest/storage-certs.
spec.fepChildCrVal.restore.repoKeySecretName		Optional Specifies the name of the Kubernetes Secret generated from the object storage key file. Specify in array format. The specified Secret will be mounted in /pgbackrest/storage-key.
spec.fepChildCrVal.restore.mcSpec.limits	cpu: 200m memory: 300Mi	Optional CPU and memory allocated to the container performing the restore
spec.fepChildCrVal.restore.mcSpec.requests	cpu: 100m memory: 200Mi	Optional CPU and memory allocated to the container performing the restore
spec.fepChildCrVal.restore.restoretype	latest	Optional Select the type of restore (latest or PITR).
spec.fepChildCrVal.restore.restoredate		Optional Specifies the date to restore when spec.fepChildCrVal.restore.restoretype is "PITR".
spec.fepChildCrVal.restore.restoretime		Optional Specifies the time to restore when spec.fepChildCrVal.restore.restoretype is "PITR".
spec.fepChildCrVal.restore.image		Optional Image of the container to perform the restore It is omitted by default. In this case, the URL for image is obtained from the operator container environment.
spec.fepChildCrVal.restore.imagePullPolicy	IfNotPresent	Optional

Field	Default	Details
spec.fepChildCrVal.upgrade		Optional When this field is defined, a major version upgrade is performed. However, if spec.fepChildCrVal.restore is defined, the FEPCluster build stops.
spec.fepChildCrVal.upgrade.sourceCluster		Specifies the FEPClusterCR name from which to migrate data. Required if spec.fepChildCrVal.upgrade is defined.
spec.fepChildCrVal.upgrade.mcSpec.limits	cpu: 200m memory: 300Mi	Optional Specifies the maximum number of resources to allocate to the upgrade execution container.
spec.fepChildCrVal.upgrade.mcSpec.requests	cpu: 100m memory: 200Mi	Optional Specifies the lower limit of resources allocated to the upgrade execution container.
spec.fepChildCrVal.upgrade.image		Optional By default, the URL of image is obtained from the operator container environment.
spec.fepChildCrVal.upgrade.imagePullPolicy	IfNotPresent	Optional Specifies the pull policy for the container image. <ul style="list-style-type: none">- Always- IfNotPresent- Never
spec.fepChildCrVal.upgrade.source.pgAdminTls.certificateName		Optional If you do not define spec.fepChildCrVal.sysUsers.pgAdminTls.certificateName for the data source, it points to the Kubernetes TLS secret that contains the certificate for the Postgres user "postgres" in the data source. If the data source FEP has set the authentication method for the upgrade execution container to "cert", then the upgrade execution container uses the certificate defined as secret.
spec.fepChildCrVal.upgrade.destination.pgAdminTls.certificateName		Optional If you have not defined the spec.fepChildCrVal.sysUsers.pgAdminTls.certificateName of the newly created FEPCluster, it points to the

Field	Default	Details
		<p>Kubernetes TLS secret that contains the certificate of the Postgres user "postgres" in the data source.</p> <p>If you create a new FEP with the "cert" authentication method for the upgrade execution container, the upgrade execution container uses the certificate defined as secret.</p>
spec.fepChildCrVal.upgrade.storage		<p>Optional</p> <p>Defines the storage for storing dump files.</p>
spec.fepChildCrVal.upgrade.storage.storageClass		<p>Optional</p> <p>If omitted, the default storage class for your environment is used.</p>
spec.fepChildCrVal.upgrade.storage.size	2Gi	<p>Optional</p> <p>Specifies the size of the storage to store the dump file.</p>
spec.fepChildCrVal.upgrade.storage.accessModes	ReadWriteOnce	<p>Optional</p> <p>accessModes for store the dump file</p> <p>Specified as an array of accessModes e.g. [ReadWriteMany]</p> <p>If omitted, it will be treated as [ReadWriteOnce]</p>
spec.fep.remoteLogging.enable		<p>Set to true to forward logs from fluentbit to fluentd</p>
spec.fep.remoteLogging.image		<p>Optional</p> <p>Fluentbit image to be used. If not specified, Operator will use the latest version that is supported by the Operator.</p>
spec.fep.remoteLogging.pullPolicy	IfNotPresent	<p>Optional</p>
spec.fep.remoteLogging.fluentdName		<p>Optional</p> <p>The name of the FEPLogging CR to which logs are transferred.</p> <p>Specify this option to use the FEPLogging function to transfer logs.</p>
spec.fep.remoteLogging.tls.certificateName		<p>Optional</p> <p>Kubernetes secret name which holds fluentbit certificate. FEPLogging will use this for certificate authentication. The certificate itself is stored in the key tls.crt.</p>
spec.fep.remoteLogging.tls.caName		<p>Optional</p> <p>Kubernetes configmap which holds cacert of Fluentd to which fluentbit will use to perform MTLs.</p>

Field	Default	Details
spec.fep.remoteLogging.mcSpec.limits.cpu	50m	Optional CPU allocation limit for fluentbit.
spec.fep.remoteLogging.mcSpec.limits.memory	60Mi	Optional Memory allocation limit for fluentbit.
spec.fep.remoteLogging.mcSpec.requests.cpu	10m	Optional CPU allocation request for fluentbit.
spec.fep.remoteLogging.mcSpec.requests.memory	5Mi	Optional Memory allocation request for fluentbit.
spec.fep.remoteLogging.fluentbitParams.memBufLimit	5MB	Optional Defines the Mem_Buf_Limit in Fluentbit. This will affect all sections that use this parameter.
spec.fep.remoteLogging.fluentbitConfigSecretRef		Optional Specifies the name of the secret containing fluent-bit.yaml when using the log transfer feature with remote logging. If fluentbitConfigSecretRef is not defined, or if fluentbitConfigSecretRef is defined but the referenced secret does not exist, the operator creates a default Secret <fep-cluster>-fluent-bit-conf and updates this parameter with <fep-cluster>-fluent-bit-conf. If the referenced secret exists, the named secret is mounted to fep-logging-fluent-bit under/fluent-bit/etc.
spec.fep.remoteLogging.awsCredentialSecretRef		Optional Specify the name of the Secret that contains authentication information to the AWS service. Authentication information stores configuration files and authentication information files. The configuration file must be named "config" and the credentials file must be named "credentials". If the referenced secret exists, the named secret is mounted to fep-logging-fluent-bit under/fluent-bit/aws.
spec.fepChildCrVal.secretStore.providerName		Optional Provider name. Can be one of the following: Azure/AWS/GCP/Vault.

Field	Default	Details
		Must be "Azure" or "azure" in case of azure provider
spec.fepChildCrVal.secretStore.csi.azureProvider.credentials		Optional Secret created by User that contains the required credentials to connect to Azure keyvault
spec.fepChildCrVal.secretStore.csi.azureProvider.tenantid		Optional Tenant id where keyvault is created
spec.fepChildCrVal.secretStore.csi.azureProvider.keyvaultName		Optional Name of the keyvault where secrets are stored
spec.fepChildCrVal.secretStore.csi.azureProvider.fepSecrets		Optional List of the parameters and their corresponding secret created in the Vault Eg: <fep parameter name>: <secret in keyvault>
spec.fepChildCrVal.secretStore.csi.azureProvider.fepCustomCert		Optional Only defined when logical replication feature is enabled
spec.fepChildCrVal.secretStore.csi.awsProvider.region		Optional AWS Region where EKS cluster is created
spec.fepChildCrVal.secretStore.csi.awsProvider.roleName		Optional Role Name for the IAM trust policy
spec.fepChildCrVal.secretStore.csi.awsProvider.fepSecrets		Optional List of the parameters and their corresponding secret created in the Vault Eg: <fep parameter name>: <secret in keyvault>
spec.fepChildCrVal.secretStore.csi.awsProvider.fepCustomCert		Optional Only defined when logical replication feature is enabled
spec.fepChildCrVal.secretStore.csi.gcpProvider.credentials		Optional Secret created by User that contains the required credentials to connect to GCP Secret Manager
spec.fepChildCrVal.secretStore.csi.gcpProvider.fepSecrets		Optional List of the parameters and their corresponding secret created in the Vault

Field	Default	Details
		Eg: <fep parameter name>: <secret in keyvault>
spec.fepChildCrVal.secretStore.csi.gcpProvider.fepCustomCert		Optional Only defined when logical replication feature is enabled
spec.fepChildCrVal.secretStore		Optional Not required to be defined if user opts to store all secrets in kubernetes environment
spec.fepChildCrVal.secretStore.csi.vaultProvider.roleName		Optional roleName created by user in the Vault
spec.fepChildCrVal.secretStore.csi.vaultProvider.vaultAddress		Optional Address of the vault that is accessible from the FEP environment
spec.fepChildCrVal.secretStore.csi.vaultProvider.fepSecrets		Optional List of the parameters and their corresponding secret created in the Vault Eg: <fep parameter name> : </path/to/secret/secretName> in vault>
spec.fepChildCrVal.secretStore.csi.vaultProvider.fepCustomCert		Optional Only defined when logical replication feature is enabled

Note

- (*) - These parameters can be specified only at creation time and should not be changed. Any change to these parameters will be ignored and will not have any effect on FEP cluster functioning.
- (**)- The storage volumes size can be increased provided underlying storage supports the operation. Optional volumes can be specified only at initial FEP cluster creation. If an optional volume is added later, operator will ignore it and no action will be taken.
- User should do or remove unsupported CR changes manually.
- spec.fep.postgres.tls CR specification should be used instead of spec.fepChildCrVal.systemCertificates. The lateral spec can still be used, however spec.fep.postgres.tls gives better flexibility to control MTLs access of the cluster.
- Either spec.fep.postgres.tls specification (old specification) or spec.fepChildCrVal.systemCertificates should be used. They should not be used interchangeable.
- Server certificate specified under spec.fep.postgres.tls can be rotated by changing the secret and executing reload (e.g. using FEPAction); however for others specified in the CR, it is required to do restart of the PoDs
- When spec.ldap.caConfigMapRef is defined, and the referenced configmap exist, the named configmap will be mounted on fep-patroni under /tls/ldap.
- When the referenced secret spec.ldap.ldapconfSecretRef exists, the named secret will be mounted on fep-patroni under /etc/openldap. The environment variable LDAPCONF=/etc/openldap/ldap.conf will be exported to the fep-patroni container. If this key is not defined, Operator will create and mount default secret <fep-cluster>-ldapconf with the following content.

- When the referenced configmap spec.ldap2pg.Ldap2pgyamlConfigMapRef exists, the named configmap will be mounted on fep-patroni under /tmp/.config. If the secret does not exist, Operator will create that named secret with the following content.

While in running state - following value will dynamically appear in the FEPCluster to reflect the cluster status

Field name	Details
status.fepStatus.fepClusterReady	Will be true or false to reflect if the whole cluster is ready. Kubernetes cluster information is fetched to check number of instances 'READY' & 'RUNNING' is equal to number of Configured instances.

Note

"fepClusterReady" flag will be set at first FEPCluster creation time only. fepClusterReady flag does not participate in the next reconciliation loop)

1.2 Custom Resource Parameters

This section explains the Custom Resource Parameters.

1.2.1 FEPCluster Custom Resource Parameters

Category	Details
CRD Name	FEPCluster
Definition	///
Operations	Create: kubectl create -f fepcluster.yaml Delete: kubectl delete fepcluster <clusername> Update: kubectl apply -f fepcluster.yaml List: kubectl get fepcluster

FEPCluster CR Example

```
apiVersion: fep.fujitsu.io/v2
kind: FEPCluster
metadata:
  name: new-fep
  namespace: new-fep
spec:
  fep:
  ///
    wuC4
    -----END CERTIFICATE-----
```

It should also be noted that all the passwords / passphrase and certificates will be masked after the creation of the CR. This includes

- Also, initial pgAdminPassword: admin-password
- pgpassword: mydbpassword
- pgreplpassword: repluserpwd
- tdepassphrase: tde-passphrase
- pgRewindPassword: rewind_password (Optional - if defined)

- pgMetricsPassword: metrics_password (Optional - if defined)
- pgSecurityPassword (if defined)
- sslpassphrase under sysTde.tdek.kmsDefinition (if defined)
- certificate.key
- certificate.crt
- certificate.cacrt

Values of child CRs at the time of initial deployment of cluster, are stored in FEPCluster under fepChildCrVals, e.g. for Server certificates, Configuration of FEP, User details.

All fields for FEPCluster CR and its child CRs should be managed through FEPCluster CR only. Operator will reflect the changes to respective child CR to be processed. The fields that not allowed to change will not be reflected from parent to child CR and hence will not have any affect.

1.2.2 FEP Cluster Configuration

Configuration of all aspects of FEP Cluster is done through FEPCluster CR only.

All fields for FEPCluster CR and its child CRs should be managed through FEPCluster CR only. Operator will reflect the changes to respective child CR to be processed. The fields that not allowed to change will not be reflected from parent to child CR and hence will not have any affect. Refer to "1.1 FEPCluster Parameter" for details.

All child CRs are marked as internal objects in RedHat OCP and will not appear on console. However, it can be checked on command line using oc or kubectl commands.

Following table shows Child CRs of FEPCluster CR and respective sections in parent CR related to given child CR.

Configuration changes are made in these sections will update allowable fields only in corresponding child CR.

Child CR Name	Relevant sections in FEP Cluster CR
FEPBackup	spec.fepChildCrVal.backup
FEPcert	spec.fepChildCrVal.systemCertificates
FEPConfig	spec.fepChildCrVal.customPgAudit spec.fepChildCrVal.customPgHba spec.fepChildCrVal.customPgParams
FEPUser	spec.fepChildCrVal.sysUsers
FEPVolume	spec.fepChildCrVal.storage

1.2.3 FEPConfig Child Custom Resource Parameters

Field	Default	Details
metadata.name	<same-as-in-FEPCluster>	This value is inherited from parent FEPCluster CR
metadata.namespace	<same-as-in-FEPCluster>	This value is inherited from parent FEPCluster CR
spec.customPgAudit	All line specified in spec.fepChildCrVal.customPg Audit of FEPCluster CR	Audit rules can be updated in this section. Requires restart. Note: initial values inherited once only at start. Changes to FEPConfig directly
spec.customPgHba	All line specified in spec.fepChildCrVal.customPg Hba of FEPCluster CR	pg_hba rules can be added in this section Note: Inherited once at start. Changes to FEPConfig directly

Field	Default	Details
spec.customPgParams	All line specified in spec.fepChildCrVal.customPg Params of FEPCluster CR	All postgres parameters are listed here to overwrite defaults. Note: Inherited once at start. Changes to FEPCluster directly
spec.replicationSlots		Optional: Details of replication slots if defined in FEPCluster

Example of FEPCluster CR created

```

apiVersion: fep.fujitsu.io/v1
kind: FEPCluster
metadata:
  name: new-fep-19ncfg
  namespace: cfg-expt
spec:
  sysExtraLogging: false
  customPgAudit: |
    # define pg audit custom params here to override defaults.
    # if log volume is not defined, log_directory should be
    # changed to '/database/userdata/data/log'
    [output]
    logger = 'auditlog'
    log_directory = '/database/log/audit'
    log_truncate_on_rotation = on
    log_filename = 'pgaudit-%a.log'
    log_rotation_age = 1d
    log_rotation_size = 0
    [rule]

  customPgHba: |
    # define pg_hba custom rules here to be merged with default rules.
    # TYPE      DATABASE      USER      ADDRESS      METHOD
  customPgParams: |+
    # define custom postgresql.conf parameters below to override defaults.
    # Current values are as per default FEP deployment
    shared_preload_libraries='pgx_datamasking,pgaudit,pg_prewarm,pg_stat_statements'
    session_preload_libraries='pg_prewarm'
    max_prepared_transactions = 100
    max_worker_processes = 20
    max_connections = 100
    work_mem = 1MB
    maintenance_work_mem = 20MB
    shared_buffers = 128MB
    effective_cache_size = 384MB
    checkpoint_completion_target = 0.8
    pgx_global_metacache = 10MB
    temp_buffers = 10MB

    # tcp parameters
    tcp_keepalives_idle = 30
    tcp_keepalives_interval = 10
    tcp_keepalives_count = 3

    # logging parameters in default fep installation
    # if log volume is not defined, log_directory should be
    # changed to '/database/userdata/data/log'    log_directory = '/database/log'
    log_filename = 'logfile-%a.log'
    log_file_mode = 0600

```

```

log_truncate_on_rotation = on
log_rotation_age = 1d
log_rotation_size = 0
log_checkpoints = on
log_line_prefix = '%e %t [%p]: [%l-1] user=%u,db=%d,app=%a,client=%h'
log_lock_waits = on
log_autovacuum_min_duration = 60s
logging_collector = on
pgaudit.config_file= '/opt/app-root/src/pgaudit-cfg/pgaudit.conf'
log_replication_commands = on
log_min_messages = WARNING
log_destination = stderr

# wal_archive parameters in default fep installation
archive_mode = on
wal_level = replica
max_wal_senders = 10
wal_keep_segments = 64
wal_sender_timeout = 60s
track_activities = on
track_counts = on

```

1.2.4 FEPUser Child Custom Resource Parameters

Field	Default	Details
metadata.name	<same-as-in-FEPCluster>	This value is inherited from parent FEPCluster CR
metadata.namespace	<same-as-in-FEPCluster>	This value is inherited from parent FEPCluster CR
spec.pgAdminPassword	spec.fepChildCrVal.users.pgAdminPassword of FEPCluster CR	postgres superuser password. Masked once secret is created/changed Note: initial values inherited once only at start. Changes to FEPUser directly
spec.pgdb	spec.fepChildCrVal.users.pgdb of FEPCluster CR	Name of a user database Note: Created once only at start. Cannot be changed
spec.pgpassword	spec.fepChildCrVal.users.pgpassword of FEPCluster CR	Password for superuser for user database pgdb. Masked once secret is created/changed Note: initial values inherited once only at start. Changes to FEPUser directly
spec.pguser	spec.fepChildCrVal.users.pguser of FEPCluster CR	Name of a user database Note: Created once only at start. Cannot be changed
spec.pgrepluser	spec.fepChildCrVal.users.pgrepluser of FEPCluster CR	Name of a database user for replication
spec.pgreplpassword	spec.fepChildCrVal.users.pgreplpassword of FEPCluster CR	Password for pgrepluser
spec.tdepassphrase	spec.fepChildCrVal.users.tdepassphrase of FEPCluster CR	Passphrase for encrypting/decrypting keystore file which contains the TDE encryption key
spec.pgRewindUser	rewind_user	Database user for Rewind

Field	Default	Details
spec.pgRewindUserPassword	rewind_password	Password for database user rewinduser
spec.pgMetricsUser	spec.fepChildCrVal.sysUsers. pgMetricsUser	Optional Refer to " 1.2.1 FEPCluster Custom Resource Parameters " for details.
spec.pgMetricsPassword	spec.fepChildCrVal.sysUsers. pgMetricsPassword	Optional Refer to " 1.2.1 FEPCluster Custom Resource Parameters " for details.
spec.pgAdminTls	spec.fepChildCrVal.sysUsers. pgAdminTls	Optional section Refer to " 1.2.1 FEPCluster Custom Resource Parameters " for details.
spec.pgrepluserTls	spec.fepChildCrVal.sysUsers. pgrepluserTls	Optional section Refer to " 1.2.1 FEPCluster Custom Resource Parameters " for details.
spec.pgRewindUserTls	spec.fepChildCrVal.sysUsers. pgRewindUserTls	Optional section Refer to " 1.2.1 FEPCluster Custom Resource Parameters " for details.
spec.pgMetricsUserTls	spec.fepChildCrVal.sysUsers. pgMetricsUserTls	Optional section Refer to " 1.2.1 FEPCluster Custom Resource Parameters " for details.

Example of FEPUser CR created

```

apiVersion: fep.fujitsu.io/v1
kind: FEPUser
metadata:
  name: new-fep-19n
  namespace: testswatiproject
spec:
  pgAdminPassword: '*****'
  pgdb: mydb
  pgpassword: '*****'
  pgreplpassword: '*****'
  pgrepluser: repluser
  pguser: mydbuser
  tdepassphrase: '*****'
  sysExtraLogging: false
  pgRewindUser: rewind_user
  pgRewindUserPassword: rewind_password
  pgAdminTls:
    certificateName: admin-client-certs-secret
    caName: admin-ssl-rootcert-configmap
    sslMode: prefer
  pgrepluserTls:
    certificateName: repluser-client-certs-secret
    caName: repluser-ca-name-configmap
    sslMode: prefer
  pgRewindUserTls:
    certificateName: rewinduser-client-certs-secret
    caName: rewinduser-ca-name-configmap
    sslMode: prefer

```


Note

- Password and Passphrase are masked in output from CR. The original values can still be found in the respective Kubernetes secrets and configmaps.
- TDE is enabled by default with given tdepassphrase and must have a value.
- TDE is enabled by using the key tdepassphrase with the desired passphrase. Do not remove this key once TDE is enabled. Otherwise, the database may go into a crash loop. If the Cluster is running on Async Replication and a failover/switchover occurred during the crash loop, there could be data lost. The team is looking at preventing the deletion of this passphrase from Operator even if customer tries to remove it in customer resource.
- Database users and their passwords managed by the FEPUUser CR should not be changed in the SQL interface. Inconsistencies with the information managed by the operator can cause problems with operator operation. If you make changes in the SQL interface, use the SQL interface again to restore the original state.

1.2.5 FEPVolume Child Custom Resource Parameters

1.2.5.1 Create Volumes

Volumes for the cluster nodes(pods) are initially created in accordance with the values set in fepChildCrVal' storage section of the parent FEPCluster CR.

The parent FEPCluster CR creates a child FEPVolume CR with the respective startup values and the relevant controller(FEPColume Controller) takes care of creating the required volumes. After initial FEPCluster create, new volume cannot be added later and storageClass or accessModes can not be changed.

Only size of an initially created volume can be changed if and only if underlying storageClass supports dynamic change of size.

Below is the schema of the FEPVolume CR:

Field	Mandatory	Sub-Field	Default	Description
archivewalVol	No	size storageClass accessModes	1Gi Defaults to platform default if omitted Defaults to ReadWriteOnce if omitted	Size of the volume,expandable later SC is only set at start Access mode is only set at start Additional details in section 3.2
backupVol	No	size storageClass accessModes	2Gi Defaults to platform default if omitted Defaults to ReadWriteOnce if omitted	-do-
dataVol	Yes	size storageClass accessModes	2Gi Defaults to platform default if omitted Defaults to ReadWriteOnce if omitted	-do-
logVol	No	size storageClass accessModes	1Gi Defaults to platform default if omitted	-do-

Field	Mandatory	Sub-Field	Default	Description
			Defaults to ReadWriteOnce if omitted	
tablespaceVol	No	size storageClass accessModes	512Mi Defaults to platform default if omitted Defaults to ReadWriteOnce if omitted	-do-
walVol	Yes	Size storageClass accessModes	1200Mi Defaults to platform default if omitted Defaults to ReadWriteOnce if omitted	-do-

1.2.5.2 Delete Volumes

Equivalent Kubernetes command: `kubectl delete FEPVolume <cr_name>`

This operation will remove all the PVCs and possibly PVs depending on the default reclaimPolicy of the storageclass used per volume.

With right backup and restore integration by customer, they may not need volumes to be persisted.



Note

Do not delete this CR unless the Cluster has been removed.

Example of FEPVolume CR created

```

apiVersion: fep.fujitsu.io/v1
kind: FEPVolume
metadata:
  name: new-fep-19n
  namespace: testswatiproject
spec:
  archivewalVol:
    size: 1Gi
  backupVol:
    size: 2Gi
  dataVol:
    size: 2Gi
  logVol:
    size: 1Gi
  tablespaceVol:
    size: 512Mi
  walVol:
    size: 1Gi
  selectedVolList:
  - name: data
  - name: tablespace
  - name: wal
  - name: log
  sysExtraLogging: false

```

1.2.6 FEPCert Child Custom Resource Parameters

1.2.6.1 Create/ Update Certificates

Certificate secret for the FEP cluster is initially created in accordance with the values set in `fepChildCrVal`' `certs` section of the parent FEPCluster CR.

Below is the schema of the FEPCert CR:

Field	Default	Description
<code>cacrt</code>	Defaults to dummy self signed crt from parent FEPCluster CR	Can be replaced with customer's own CA cert
<code>crt</code>	Defaults to dummy self signed crt from parent FEPCluster CR	Can be replaced with customer's own trusted cert
<code>key</code>	Defaults to dummy key from parent FEPCluster CR	Can be replaced with customer's own key

By default, Operator will create Kubernetes secrets to store the CA Cert, Server Cert and Key file. These files are exposed under the mount point `/fep-certs` in the container. The default FEPCluster template will also set the following postgres parameters in `postgresql.conf`.

```
ssl = on
ssl_cert_file = '/fep-certs/fep.crt'
ssl_key_file = '/fep-certs/fep.key'
ssl_ca_file = '/fep-certs/ca.crt'
```

It should also be possible to change the certificates by end user, by changing ALL `key`, `crt` and `cacrt`. However, user will need to restart the cluster to let change take effect.

1.2.6.2 Delete Certificates

Equivalent Kubernetes command: `kubectl delete FEPCert <cr_name>`

This operation will remove the secret containing the TLS Certificates and keys for the cluster.

Below is an example CR for certificates to be used by FEP server container

```
apiVersion: fep.fujitsu.io/v1
kind: FEPCert
metadata:
  name: new-fep
  namespace: ansible-operator-poc
spec:
  key: |-
    -----BEGIN RSA PRIVATE KEY-----
    MIIEowIBAAKCAQEAA4AI33yvHZws+jta6qpV6wzJqF8odIfTIpCfbrVcUUtLFKJlI
    2e4SceTKi603C/I1XuvWlpng5IO65+fQQL006z1/AuQT78YUn/Wlm9x1aHVsv4AN
    B5JWWqDOjRT3o7nRPGXf ilabP0rGE2mJcVR9nExJ3leaktgT3sb8YlXvtchyYp
    mjdbfxabTz07ig0+6/cwKoRRxOK8Uf7f5euE0cI/490J6r5Rs41gD8sIQNCUF1TF
    YvmAH7gdcsssFBt8NP1UATHESoFmlW0DKCJWNhTLOht+s6L/1zwTHLjPG2pdkG6W
    dgmu5H2pDml8CDNLDv98Aj7i+I5SRKKcVPlnuQIDAQABAoIBAFFPQYKlOzw/+BA0b
    yMIUpdctIMb/54CR/xR0mVw1DbSjigNVPjHUQvB8Y1B2FAITQObgJO06bAv0QdWN
    Rb0/v/yYiNJDfjaLjaIAHlO/2+oWrXbFaZqgpVDJhB+e1xaZr2x7XGxm+p925k30
    16pvIRY+I8JRKvziV1VZHwL/R3JOtPr++xMZtLVjVOI+f+ySqJ+TZHuAjm49EKxj
    cEmmJ28b7QcziXsvKy00f+zbqLIBKXQdZAFU5eEr1BsDRXdRW+KfOXIvftuy4BJZ
    voKT+VGHvEvF/qysslwL4+6IAO6tpuYnnM0Y2d3sOGowPktCqK0MekYkZL/WmtCjNs
    9hodJtECgyEA5EWyhEof4u0Ke5TDp697UCUvXLoOR58FDe/S8XNvScn29jjOkqIg
    OMogo9xAkJTNTZqn5UUdt1x/pgM2NxlPLFi jrc0zQlX3SoO02ryDd9Wni7YKtNl6
    KJqa536WeZu20EbuAZ+S3GALVy1RPeTNPnuUomKnF06DjDUGzLNCZy10CgYEA+zfw
    952DWuz1U0Z4wvAEqqcgUKXPKrkTXV/iUnjkDkrLYVr0ZofDNTXrdHl+UedFmaOC
    cieZn6DNhcdz5tKtyysGMH3g/qs9PfoGungvcXsy0Egk0413x1jC8TTCLqXZXYaQ
```


Field	Default	Details
apiVersion	fep.fujitsu.io/v1	Fixed
kind	FEPBackup	Fixed
metadata.name	<clustername>	Enter the CR name.
spec.pgbackrestParams	" "	" " It is fixed, and the parameter set in pgbackrest.conf is described from the line below.
spec.schedule.num	Integer	Number of schedules to set The maximum number of backup schedules is 5.
spec.scheduleN.schedule	-	Write the date and time of the Nth schedule in cron format. The date and time is UTC time.
spec.scheduleN.type	full/incr	full: Perform a full backup (Back up the contents of the database cluster). incr – Perform an incremental backup (Back up only the database cluster files that were changed to the last backup migration).
spec.preScript	" "	This parameter must specify a default value.
spec.postScript	" "	This parameter must specify a default value.

Example of FEPBackup CR created

```

apiVersion: fep.fujitsu.io/v1
kind: FEPBackup
metadata:
  name: fepcluster-backup
spec:
  schedule:
    num : 2
  schedule1:
    schedule : "0 0 1 * *"
    type : "full"
  schedule2:
    schedule : "0 0 1-6 * *"
    type : "incr"
  preScript: " "
  postScript: " "
  pgbackrestParams: |
    # define custom pgbackrest.conf parameters below to override defaults.
    [global]
    rep1-retention-full = 30
    rep1-retention-full-type = time
...

```

1.2.8 FEPRestore Custom Resource Parameters

Field	Default	Details
apiVersion	fep.fujitsu.io/v1	Fixed
kind	FEPRestore	Fixed
metadata.name	-	Enter the CR name.
spec.fepVersion		Optional

Field	Default	Details
		To use FEPRestore image of given version. Possible values: 12, 13, 14, 15, 16 & 17
spec.image	<current-released-image>	FEP restore container image to be used quay.io/fujitsu/fujitsu-enterprise-postgres-17-restore:ubi9-17-1.0 It is optional. Image is left blank by default. In such a case, it will pick up URL of image from operator container environment. If you specify the image, Operator will take that image to deploy container
spec.imagePullPolicy	IfNotPresent	
spec.mcSpec.limits	cpu: 0.2 memory: "300Mi"	
spec.mcSpec.requests	cpu: 0.1 memory: "200Mi"	
spec.fromFEPcluster	<from_clustername>	The name of the FEPcluster from which to restore
spec.toFEPcluster	<to_clustername>	Specifies the name of the FEP cluster to restore to. When restoring to an existing cluster, do not specify the line of this parameter.
spec.restoretype	latest/PITR	latest - Restore Latest State PITR - Date-Time Restore
spec.restoredate	-	If spec.restoretype is PITR, specify the day of PITR (UTC) in YYYY-MM-DD format Be sure to use single quotes. Example) '2020-11-25'
spec.restoretime	-	If spec.restoretype is PITR, specifies the PITR time (UTC) in HH: MM: SS format Be sure to use single quotes. Example) '02:50:43'
spec.restoreTargetRepo		Optional If you are using multiple repositories, specify the repository from which to restore. If not specified, "1" is substituted.
spec.changeParams.fepChildCrVal.backup.pgbackrestParams		Optional Specify this to change the spec.fepChildCrVal.backup.pgbackrestParams setting in FEPClusterCR when restoring to a new DB cluster.
spec.changeParams.fepChildCrVal.backup.pgbackrestKeyParams		Optional Specify this to change the spec.fepChildCrVal.backup.pgbackrestKeyParams setting in FEPClusterCR when restoring to a new DB cluster.

Field	Default	Details
spec.changeParams.fepChildCrVal.backup.caName		Optional Specify if you want to change the spec.fepChildCrVal.backup.caName setting of FEPClusterCR when restoring to a new DB cluster.
spec.changeParams.fepChildCrVal.backup.repoKeySecretName		Optional Specify if you want to change the spec.fepChildCrVal.backup.repoKeySecretName setting of FEPClusterCR when restoring to a new DB cluster.
spec.changeParams.fepChildCrVal.storage.backupVol		Optional Specify this to change the spec.fepChildCrVal.storage.backupVol setting in FEPClusterCR when restoring to a new DB cluster.
spec.changeParams.fepChildCrVal.storage.archivewalVol		Optional Specify this option to change the spec.fepChildCrVal.storage.archivewalVol setting for FEPClusterCR when restoring to a new DB cluster.
spec.changeParams.fepChildCrVal.storage.dataVol		Optional Specify this to change the spec.fepChildCrVal.storage.dataVol setting for FEPClusterCR when restoring to a new DB cluster.
spec.changeParams.fepChildCrVal.storage.walVol		Optional Specify this to change the spec.fepChildCrVal.storage.walVol setting for FEPClusterCR when restoring to a new DB cluster.
spec.changeParams.fepChildCrVal.storage.logVol		Optional Specify this to change the spec.fepChildCrVal.storage.logVol setting for FEPClusterCR when restoring to a new DB cluster.
spec.changeParams.fepChildCrVal.storage.tablespaceVol		Optional Specify this to change the spec.fepChildCrVal.storage.tablespaceVol setting for FEPClusterCR when restoring to a new DB cluster.

Example of FEPRestore CR created

```

apiVersion: fep.fujitsu.io/v1
kind: FEPRestore
metadata:
  name: feprestore
spec:
  mcSpec:
    limits:
      cpu: 200m
      memory: 300Mi
    requests:
      cpu: 100m
      memory: 200Mi
  fromFEPcluster: fepcluster1
  toFEPcluster: fepcluster2

```

```
restoretype: latest
imagePullPolicy: IfNotPresent
```

Example of Point-In-Time-Recovery using FEPRestore CR

```
apiVersion: fep.fujitsu.io/v1
kind: FEPRestore
metadata:
  name: feprestore
spec:
  mcSpec:
    limits:
      cpu: 300m
      memory: 700Mi
    requests:
      cpu: 200m
      memory: 512Mi
  fromFEPcluster: fepclusterA
  toFEPcluster: fepclusterB
  restoretype: PITR
  restoredate: 2020-11-25
  restoretime: 02:50:43
  imagePullPolicy: IfNotPresent
```



Note

Upon successful completion, custom resources in FEPRestore are automatically deleted.

You can specify `spec.changeParams` in the FEPRestore custom resource to modify the definition from the source to build a new FEPCluster and restore the data.

This allows you to mount another storage in the new cluster, for example, to expand the PVC size, even if you are using storage that does not support PVC extensions.

Example of a FEPRestore Custom Resource for Modifying the Storage Class and Storage Capacity of a FEPCluster "source-cluster"

```
apiVersion: fep.fujitsu.io/v1
kind: FEPRestore
metadata:
  name: feprestore
spec:
  mcSpec:
    limits:
      cpu: 300m
      memory: 700Mi
    requests:
      cpu: 200m
      memory: 512Mi
  fromFEPcluster: source-cluster
  toFEPcluster: new-cluster
  restoretype: latest
  changeParams:
    fepChildCrVal:
      storage:
        dataVol:
          size: 50 Gi
          storageClass: new-storage
```


1.2.9 FEPPgpool2 Custom Resource Parameters

Equivalent Kubernetes command: `kubectl create FEPPgpool2`

This operation will create a PGPool2 with supplied information.

Field	Default	Details
apiVersion	fep.fujitsu.io/v1	Fixed
kind	FEPPgpool2	Fixed
metadata.name	-	List the name of the FEP Pgpool2 container.
metadata.namespace	-	Specify the namespace of the environment where you want to deploy the operator.
spec.fepVersion		Optional To use FEPPgpool2 image of given version. Possible values: 12, 13, 14, 15, 16 & 17
spec.image	<current-released-image>	FEPPgpool2 container image to be used quay.io/fujitsu/fujitsu-enterprise-postgres-17-pgpool2:ubi9-17-1.0 It is optional. Image is left blank by default. In such a case, it will pick up URL of image from operator container environment. If you specify the image, Operator will take that image to deploy container.
spec.count	2	List the number of FEP Pgpool2 containers to create.
spec.serviceport	9999	Describes the TCP port for connecting to the FEP Pgpool2 container.
spec.statusport	9898	Identifies the TCP port for connecting to the PCP process.
spec.limits.cpu	400m	List the number of CPUs (restriction) to allocate to resources.limits.cpu.
spec.limits.memory	512Mi	Specifies the memory size (restriction) to allocate to resources.limits.memory.
spec.requests.cpu	200m	List the number of CPUs (request) to allocate to resources.requests.cpu.
spec.requests.memory	256Mi	Specifies the memory size (request) to allocate to resources.requests.memory
spec.fepclustername	new-fep	Enter the FEPCluster name to connect to.
spec.customhba		If you want to use pool_hba.conf, describe what pool_hba.conf should contain from the line below.
spec.customparams	listen_addresses = '*' pcp_listen_addresses = '*' num_init_children = 32 reserved_connections = 0 enable_pool_hba = off allow_clear_text_frontend_auth = off authentication_timeout = 80	" " and the Pgpool-II parameters. Refer to " Pgpool-II parameters " for detail.

Field	Default	Details
	backend_weight0 = 1 backend_weight1 = 1 backend_flag0 = 'ALWAYS_PRIMARY' backend_flag1 = 'DISALLOW_TO_FAILOVE R' connection_cache = on max_pool = 4 listen_backlog_multiplier = 2 serialize_accept = off child_life_time = 300 client_idle_limit = 0 child_max_connections = 0 connection_life_time = 0 reset_query_list = 'ABORT; DISCARD ALL' client_min_messages = info log_min_messages = debug1 log_statement = on log_per_node_statement = on log_client_messages = on log_hostname = on log_connections = on log_line_prefix = '%t: pid %p:' load_balance_mode = on ignore_leading_white_space = on white_function_list = " black_function_list = 'currval,lastval,nextval,setval' black_query_pattern_list = " database_redirect_preference_ list = " app_name_redirect_preferenc e_list = " allow_sql_comments = off disable_load_balance_on_writ e = 'transaction' statement_level_load_balance = on sr_check_period = 0	

Field	Default	Details
	sr_check_user = 'postgres' delay_threshold = 0 log_standby_delay = 'none' ssl = on ssl_ciphers = 'HIGH:MEDIUM:+3DES:! aNULL' ssl_prefer_server_ciphers = off ssl_ecdh_curve = 'prime256v1' ssl_dh_params_file = " relcache_expire = 0 relcache_size = 256 check_temp_table = catalog check_unlogged_table = on enable_shared_relcache = off relcache_query_target = primary wd_port0 = 9000 failover_on_backend_error = off	
spec.custompcp	" "	If you use the pcp command, " " and the contents of pcp.conf from the line below.
spec.customsslkey	" "	If you want to do it, " " and the Beethoven key content in the line below.
spec.customsslcert	" "	If you want to do it, " " and the contents of the public x 509 certificate from the line below.
spec.customsslca	" "	If you want to do it, " " and the following lines describe the contents of the CA root certificate in PEM format.
spec.customlogsize	100 Mi	Specifies the persistent volume size for log output.
spec.storageclassname		Specifies the storage class for log output. NFS storage is not available if you enable the following parameters: <ul style="list-style-type: none"> - enable_shared_relcache - memory_cache_enabled
spec.clientAuthMethod		Optional Specifies the method for client authentication. Define "scram" to use scram-sha-256 authentication. Otherwise, the client authentication method is still md5.
spec.scram.pgpoolkeySecret		Optional Describes the name of the secret that stores the key for use in encryption/decryption. Can only be specified at creation time.

Field	Default	Details
		If you change the contents of the specified secret, a restart is required.
spec.scram.userinfoSecret		Optional Write the name of the secret that contains the user name you added and the password that corresponds to that user. Can only be specified at creation time.

Pgpool-II parameters

The parameters that can be specified are shown in the table below. For details on the parameters, refer to the Pgpool-II manual.

Category	Parameter name (Specified format)	Restart required after change
Connection settings	listen_addresses (string)	Y
	pcp_listen_addresses (string)	Y
	num_init_children (integer)	Y
	reserved_connections (integer)	Y
Authentication settings	enable_pool_hba (boolean)	
	allow_clear_text_frontend_auth (boolean)	
	authentication_timeout (integer)	
Backend settings	backend_weight0 (floating point)	
	backend_weight1 (floating point)	
	backend_flag0	
	backend_flag1	
Connection pooling	connection_cache (boolean)	Y
	max_pool (integer)	Y
	listen_backlog_multiplier (integer)	Y
	serialize_accept (boolean)	Y
	child_life_time (integer)	Y
	client_idle_limit (integer)	
	child_max_connections (integer)	Y
	connection_life_time (integer)	Y
reset_query_list (string)		
Error reporting and log acquisition	client_min_messages (enum)	
	log_min_messages (enum)	
	log_statement (boolean)	
	log_per_node_statement (boolean)	
	log_client_messages (boolean)	
	log_hostname (boolean)	
	log_connections (boolean)	
	log_error_verbosity (enum)	
log_line_prefix (string)		

Category	Parameter name (Specified format)	Restart required after change
Load sharing settings	load_balance_mode (boolean)	Y
	ignore_leading_white_space (boolean)	
	white_function_list (string)	
	black_function_list (string)	
	black_query_pattern_list (string)	
	database_redirect_preference_list (string)	
	app_name_redirect_preference_list (string)	
	allow_sql_comments (boolean)	
	disable_load_balance_on_write (string)	Y
statement_level_load_balance (boolean)		
Health check	connect_timeout (integer)	
Streaming replication check	sr_check_period (integer)	
	sr_check_user (string)	
	sr_check_password (string)	
	sr_check_database (string)	
	delay_threshold (integer)	
	log_standby_delay (string)	
Secure Socket Layer (SSL)	ssl (boolean)	Y
	ssl_ciphers (string)	Y
	ssl_prefer_server_ciphers (boolean)	Y
	ssl_ecdh_curve (string)	Y
	ssl_dh_params_file (string)	Y
Other parameters	relcache_expire (integer)	Y
	relcache_size (integer)	Y
	enable_shared_relcache (boolean)	Y
	relcache_query_target (enum)	
	check_temp_table (enum)	
	check_unlogged_table (boolean)	

1.2.10 FEPAAction Custom Resource Parameters

Specify parameters in the format described below.

Custom resource spec	Default	Change effect
.spec.targetClusterName		Must specify target FEP Cluster name within namespace mentioned in metadata.
.spec.targetPgpool2Name		Must specify target FEPPgpool2 name within namespace mentioned in metadata when using pgpool2_restart.
.spec.fepAction.type		Must specify action type. Supported action types are: restart

Custom resource spec	Default	Change effect
		pod_restart reload list switchover failover pgpool2_restart backup open_tde_masterkey create_extension update_admin_password backup_expire promote_standby fixed_stats
.spec.fepAction.args		Must specify arguments needed for given action. For details of args corresponding to each action refer to " 1.2.10.1 FEPAction Specific Operation Details ".
.spec.fepAction.backupType	full	Options If you specify backup for fepAction.type, the type of backup is used. full : Performs a full backup (backs up the contents of the database cluster). incr : Perform an incremental backup (Back up only the database cluster files that were changed during the last backup migration).
.spec.fepAction.backupRepo	1	Options Gets a backup in the specified repository. The range is 1 to 256.
.spec.sysExtraLogging		To turn extra debugging on, set value to true. It can be turned on/off at any time.

After execution of FEPAction CR, status is reflected in fepStatus field that is dynamically inserted in current FEPAction CR as needed. fepStatus field used for FEPAction CR are described here

fepStatus (with possible values)	Remarks
fepActionStatus:	fepStatus is inserted at the top of FEPAction CR
fepActionCondition: Success Failure	This flag is inserted in fepAction CR to reflect success or failure of requested action
fepActionResult: > "details"	The result contains verbose details corresponding to the specific action been executed. Should be noted that it is either plain text of HTTP output.
processedTimestamp: <time stamp>	Denotes time of action execution by the Operator

```
apiVersion: fep.fujitsu.io/v1
kind: FEPAction
fepActionStatus:
  fepActionCondition: Success
metadata:
  name: new-fep-reload-action
  namespace: myns
```

```
spec:
  fepAction:
    args:
      - new-fep-sts-0
      - new-fep-sts-1
    type: reload
  sysExtraLogging: false
  targetClusterName: new-fep
```

Note

- Please do not use the FEPAction to perform a switchover or restart while executing backup. Failed to get the backup.
- You must create a new FEPAction custom resource for each operation.

1.2.10.1 FEPAction Specific Operation Details

Action type - reload

The reload action will manually reload the FEP database on the targeted FEPCluster.

"reload" action type expects users to specify the name of individual FEP pods that they want to run the database reload operation on. They specify that in the args section under the FEPAction CR spec as below :

```
spec:
  fepAction:
    args:
      - nf-131851-sts-0
      - nf-131851-sts-1
    type: reload
  targetClusterName: nf-131851
```

Action type - restart

The restart action will manually restart the FEP database on the targeted FEPCluster.

"restart" action type expects users to specify the name of individual FEP pods that they want to run the database restart operation on. They specify that in the args section under the FEPAction CR spec as below:

```
spec:
  fepAction:
    args:
      - nf-131851-sts-0
      - nf-131851-sts-1
    type: restart
  targetClusterName: nf-131851
```

Action type - pod_restart

The pod_restart action will restart specified list of POD for given target cluster. User can specify key word 'ALL' under 'args' section to restart all pods in target cluster. Alternatively, user can give the list of pods to be started in target cluster. User should either give ALL or the list of the pods.

This action restarts the replica pods first. Once all replicas have been restarted, it switches over the mastership to one of the replica before restarting old master pod. If it is a single node cluster, master will be restarted in its current state. This action is automatically created to restart pods when image or machine specs are changed for fep or backup container depending on autoPodRestart flag in FEPCluster CR (Refer to "1.2.1 FEPCluster Custom Resource Parameters" for details.):

```
spec:
  fepAction:
    args:
      - nf-131851-sts-0
```

```
- nf-131851-sts-1
type: pod_restart
targetClusterName: nf-131851
```

Action type - list

The list action will return the status of the targeted FEPCluster.

"list" action type expects users to specify just the target cluster name to list the details of the same. Looks like below:

```
spec:
fepAction:
  type: list
targetClusterName: nf-131851
```

Action type - switchover

The switchover action performs a manually switchover of the current leader/primary database from one pod to another pod of the targeted FEPCluster.

"switchover" action type expects users to specify the name of the target cluster that they want to perform switchover. args section is not required for switchover as FEPACTION operator code will internally find it and promote new master. FEPACTION CR spec as below:

```
spec:
fepAction:
  type: switchover
targetClusterName: nf-131851
```

Action type - failover

The failover action performs a manually failover of the current primary database from one pod to another pod of the targeted FEPCluster. The difference between switchover and failover is that, switchover expects the primary database is running at the time whereas failover can force switchover of primary role from a non-responding pod to another pod. Note that failover is a disruptive action and may cause data lost.

"failover" action type expects users to specify the names of the candidate pods that they want to failover to. They specify that in the args section under the FEPACTION CR spec as below:

```
spec:
fepAction:
  args:
  - nf-131851-sts-1
  - nf-131851-sts-2
  type: failover
targetClusterName: nf-131851
```

Here, nf-131851-sts-1 and nf-131851-2 are the candidate pods to failover to. In this example, the current primary pod would be nf-131851-sts-0.

Action type - pgpool2_restart

"pgpool2_restart" action type expects users to specify the name of individual FEPPgpool2 resource that they want to restart operation on. They specify that in the targetPgpool2Name section under the FEPACTION CR spec as below:

```
spec:
fepAction:
  type: pgpool2_restart
targetPgpool2Name: nf-131851-pgpool2
```

Action type - backup

The "backup" action performs a backup on the target FEPCluster.

The "backup" action type requires you to specify the type of backup and the repository in which to store the data.

In the fepAction section of the FEPACTION custom resource specification, specify the following:


```
spec:
  targetClusterName: new-fep
  fepAction:
    type: backup
    backupType: full
    backupRepo: 1
```

Note

- Regardless of how the backup was performed (scheduled or FEPAction), if backups were performed at the same time by the same FEPCluster, subsequent backups will fail.
- If the backup repository Retention Option is specified in the FEPCluster custom resource spec.fepChildCrVal.backup.pgbackrestParams, the backup files obtained by the FEPAction are also deleted as specified by the option.

Action type - open_tde_masterkey

The open_tde_masterkey action opens a keystore for a TDE-enabled target cluster.

The "open_tde_masterkey" action type requires the user to specify the name of the target cluster on which the keystore will be opened. The args section is not required.

Specify the following:

```
spec:
  targetClusterName: nf-131851
  fepAction:
    type: open_tde_masterkey
```

Action type - create_extension

The create_extension action executes "CREATE EXTENSION" on the target FEPCluster and installs the extension.

In fepAction.args, specify the "extension name, version", "database", "schema", and "apply CASCADE options" to be installed.

Parameters specified by args	Description
extension	Required Specify the extension and version to be installed.
version	Optional Specifies the version of the extension to be specified for the VARSION option. If omitted, the VARSION option is omitted.
database	Option Specifies the database to install. If omitted, install in the "postgres" database.
schema	Option Specifies the schema to be installed, which is specified in the SCHEMA option. If omitted, the SCHEMA option is omitted.
cascade	Option true or false Enables or disables the CASCADE option for CREATE EXTENSION. If omitted, false.

An example specification is shown below.

```
spec:
  targetClusterName: new-fep
```

```

fepAction:
  type: create_extension
  args:
    extension: "vci"
    version: "2.0"
    database: "mydb"
    schema: "public"
    cascade: "true"

```

Action type - update_admin_password

The update_admin_password action redefines the password for SUPERUSER "postgres" on the target FEPCluster with a random value. This action will be executed when the FEPCluster custom resource spec.fepChildCrVal.sysUsers.pgAdminPassword is not defined. An example specification is shown below.

```

spec:
fepAction:
type: update_admin_password
targetClusterName: new-fep

```

Action type - backup_expire

You can run the "pgbackrest expire" command on the FEPPod to remove expired backups.

The "pgbackrest expire" command is normally run automatically upon a successful backup, but it can be run by the user, for example, when the definition of the number of generations to retain for a backup is reduced, and the backup data can be deleted so that the number of retained generations conforms to the changed definition.

If you want to reduce the number of backup retention generations and free up disk space, apply "backup_expire" in the FEPAction after changing the retention setting for backup data under the FEPCluster custom resource fepChildCrVal.backup.pgbackrestParams.

You can specify the repository from which to remove the backup by specifying args.repo.

Parameters specified by args	Description
repo	Options Specified value: integer Specifies the number of the repository from which to remove the backup. If omitted, delete the backup for all backup repositories.



Note

The number of the backup repository must be N for repoN-type, as defined in the FEPCluster custom resource spec.fepChildCrVal.backup.pgbackrestParams.

The following is an example of changing the retention setting for backup data in a FEPCluster custom resource.

You want to reduce the number of backup generations stored in S3.

```

spec:
  fepChildCrVal:
    backup:
      pgbackrestParams:
        repo2-type=s3
        repo2-retention-full=5 # Change it to the number of generations you want to keep
        repo2-retention-full-type=time

```

The following is an example of a FEPAction custom resource that reduces the number of backup generations:

Since the backup repository for s3 is specified as repo2-type in pgbackrestParams, specify 2 for spec.fepAction.repo.

```

apiVersion: fep.fujitsu.io/v1
kind: FEPAction
metadata:
  name: backup-expire-action
spec:
  targetCluster: new-fep
  fepAction:
    type: backup_expire
    args:
      repo: 2

```

Action type - promote_standby

promote_standby promotes the FEP database in the disaster recovery environment from Standby DB to Primary DB. You must specify the DB cluster to be promoted.

The following shows a specification example.

```

spec:
  fepAction:
    type: promote_standby
    targetClusterName: my-fep

```

Action type - fixed_stats

The fixed_stats action performs a statistics operation (pg_dbms_stats) on the target FEPCluster.

The fixed_stats action must specify the operations that can be performed by pg_dbms_stats. Specify fixedStatsType: < operation type > in spec.fepAction.args. Depending on the operation type, there are additional required and optional arguments. Refer to the table below.

Table 1.1 Operation Types and Arguments

Operation Type	Required Arguments	Optional Argument
backup	None All databases are backed up with statistics. Also, if an identifying comment is omitted, "FEPAction" is assigned as the comment.	targetDb: Target database fixedObject: Name of the object after the schema Example)Target specific columns fixedObject: myschema.mytable.myclomun comment: "XXX"
restore	targetDb: Target database backupId: Backup ID or timestamp: timestamp The data type is timestamptz. The statistics are pinned using the specified backup ID or the most recent backup before the specified time.	Only when timestamp is defined can a post-schema object be specified. fixedObject: Name of the object after the schema Example)Target specific columns fiexdObject: myschema.mytable.myclomun
purge	backupId: Backup ID targetDb: Target data base Erases backups before the specified backup ID for the database specified in targetDb.	You can specify a delete flag. force: true force: false If omitted, it will be executed as false.
lock	targetDb: Target data base Fix statistics for the specified database.	fixedObject: Name of the object after the schema Example)Target specific columns fixedObject: myschema.mytable.myclomun

Operation Type	Required Arguments	Optional Argument
unlock	targetDb: Target data base Unpin statistics performed on the specified database.	fixedObject: Name of the object after the schema Example)Target specific columns fixedObject: myschema.mytable.myclomun
cleanup	targetDb: Target data base Performs a statistics cleanup on the specified database.	None
import	targetDb: Target data base Fixes statistics from a binary file for the database specified in targetDb. The file is imported from the fep.fixedStats.endpoint.protocol information defined in the FEPCluster custom resource. protocol changes the required arguments. See " Table 1.2 Required Arguments Per Protocol ".	fixedObject: Name of the object after the schema
export	targetDb: Target data base targetStats: Valid and regular statistics Which to export (effective or plain) Exports the currently valid or canonical statistics for the database specified in targetDb. The file export destination uses the fep.fixedStats.endpoint. protocol information defined in the FEPCluster custom resource. protocol changes the required arguments. See " Table 1.2 Required Arguments Per Protocol ".	fixedObject: Name of the object after the schema

Table 1.2 Required Arguments Per Protocol

Protocol	Required Arguments	Description
s3, gcs	url	URL of object storage
blob	azureBlobName	BLOB name of the statistics binary file
	azureContainerName	Container name of the Azure storage account
local	file	Specify the name of the file to which statistics will be exported/imported.

The following shows a specification example.

```

apiVersion: fep.fujitsu.io/v1
kind: FEPAction
metadata:
  name: fep-action-firxdStats
spec:
  fepAction:
    targetClusterName: new-fep
    type: fixed_stats
    args:
      fixedStatsType: backup
      targetDb: mydb
      fixedObject: schema.table.attaname
      comment: "xxyyzz"

```

1.2.11 FEPEXporter Custom Resource

Field	Default	Details
apiVersion	fep.fujitsu.io/v1	Mandatory as it is
kind	FEPEXporter	Mandatory as it is
metadata.name	fep-monitor	Name of FEPEXporter CR - must be unique in namespace
metadata.namespace	fep-ns	Namespace - OCP populates it as current
spec.prometheus		Optional Prometheus MTLS spec section
spec.prometheus.tls		
spec.prometheus.tls.certificateName		Optional This points to Kubernetes TLS secret that contains the certificate of Prometheus ServiceMonitor. FEPEXporter will use this for certificate authentication. The certificate itself is stored in the key tls.crt.
spec.prometheus.tls.caName		Optional This points to Kubernetes configmap that contains additional CA the client use to verify a server certificate. The CA is stored in the key ca.crt.
spec.fep.remoteLogging.enable		Set to true to forward logs from fluentbit to fluentd
spec.fep.remoteLogging.image		Optional Fluentbit image to be used. If not specified, Operator will use the latest version that is supported by the Operator.
spec.fep.remoteLogging.pullPolicy	IfNotPresent	Optional
spec.fepExporter.		Exporter spec section
spec.fepExporter.authSecret		Optional Base Authentication secret to provide username & encrypted password of user
spec.fepExporter.authSecret.secretName		Secret name
spec.fepExporter.authSecret.usernameKey		Key of username in specified secret
spec.fepExporter.authSecret.passwordKey		Key of password in specified secret
spec.fepExporter.customLabel		Custom label to be added to Prometheus ServiceMonitor
spec.fepExporter.tls		FEPEXporter MTLS specs
spec.fepExporter.tls.certificateName		Optional This point to Kubernetes TLS secret that contains the certificate of FepExporter. Prometheus will use this for certificate authentication. The certificate itself is stored in the key tls.crt.
spec.fepExporter.tls.caName		Optional This points to Kubernetes configmap that contains additional CA the client use to verify a server certificate. The CA is stored in the key ca.crt.

Field	Default	Details
spec.fepExporter.disableDefaultQueries	false	Optional Not defined or set to false => Create default queries Defined and set to true => Do not create default queries.
spec.fepExporter.disableDefaultAlertRules	false	Optional Not defined or set to false => Create default alert rules Defined and set to true => Do not create default alert rules. If Default queries are disabled => Do not create default alert rule.
spec.fepExporter.exporterLogLevel	error	Set logging level: one of debug, info, warn, error
spec.fepExporter.fepClusterList		Array of FEPCluster to monitor
spec.fepExporter.image.image		quay.io/fujitsu/fujitsu-enterprise-postgres-exporter:ubi9-17-1.0 Optional If not specified; image name is picked up from operator environment variable
spec.fepExporter.image.pullPolicy	IfNotPresent	Always or IfNotPresent
spec.fepExporter.mcSpec.limits	cpu: 500m memory: 700Mi	Max CPU allocated to exporter container Max memory allocated to exporter container
spec.fepExporter.mcSpec.requests	cpu: 200m memory: 512Mi	CPU allocation at start for exporter container memory allocation at start for exporter container
spec.fepExporter.scrapeInterval	30s	Optional This parameter may be specified to change statistics scraping frequency. If specified, Prometheus will poll FEPEXporter at given interval. CHANGE THIS PARAMETER ONLY IF REALLY REQUIRED
spec.fepExporter.scrapeTimeout	30s	Optional This parameter may be specified to change statistics scraping timeout. If specified, Prometheus will wait for FEPEXporter for maximum this given period to return statistics. CHANGE THIS PARAMETER ONLY IF REALLY REQUIRED
spec.fepExporter.sysExtraLogging	true	To turn on extra debugging messages for operator, set value to true <i>It can be turned on/off at any time</i>
spec.fepExporter.sysExtraEvent		Optional. To turn on event notification for custom resource changes, set the value to true. Can be turned on or off at any time.
spec.fepExporter.restartRequired	false	true: To restart FEPEXporter, when there is any change found in CR or FEPCluster false: Will not restart FEPEXporter
spec.fepExporter.userCustomQueries		Optional Section Example user's custom query to extract additional metrics.

```

usr_example:
  query: "SELECT EXTRACT(EPOCH FROM (now() - pg_last_xact_replay_timestamp())) as lag"
  master: true
  metrics:
    - lag:
        usage: "GAUGE"
        description: "Replication lag behind master in seconds"

```

1.2.12 FEPAutoscale Custom Resource

When FEPClusterCR is defined, FEPAutoscaleCR is defined.

The parameters are as follows:

Configuration changes are made in FEPClusterCR.

Field	Default	Details
apiVersion	fep.fujitsu.io/v1	Fixed
kind	FEPAutoscale	Fixed
metadata.name	Same as FEPClusterCR	Fixed
metadata.namespace	Same as FEPClusterCR	Fixed
spec.scaleout.policy	off	[cpu_utilization/connection_number/off]
spec.scaleout.threshold	cpu_utilization: 40 connection_number: 40	Threshold
spec.scaleout.metricName	pg_capacity_connection_aver age	Specify this parameter if policy is connection_number. The custom metrics server must publish the average number of connections in the FEP cluster under this name.
spec.scaleout.stabilizationWindowSeconds	0	If the duration (seconds) threshold of this parameter has been exceeded continuously, a scale out is performed.
spec.limits.maxReplicas	2	Maximum number of replicas (0 to 15) If the value is out of range, no automatic scale out is performed.

1.2.13 FEPUUpgrade Custom Resource

If "spec.fepChildCrVal.upgrade" is defined for the FEPCluster custom resource, the FEPUUpgrade custom resource is defined.

The parameters are as follows:

Field	Default	Details
apiVersion	fep.fujitsu.io/v1	Fixed
kind	FEPUUpgrade	Fixed
metadata.name	Same as FEPClusterCR	Fixed
metadata.namespace	Same as FEPClusterCR	Fixed
spec.upgrade		
spec.upgrade.sourceCluster		Specifies the FEPClusterCR name from which to migrate data. Required.
spec.upgrade.mcSpec.limits	cpu: 200m	Optional

Field	Default	Details
	memory: 300Mi	Specifies the maximum number of resources to allocate to the upgrade execution container.
spec.upgrade.mcSpec.requests	cpu: 100m memory: 200Mi	Optional Specifies the lower limit of resources allocated to the upgrade execution container.
spec.upgrade.image		Optional If omitted, the URL for image is obtained from the operator container environment.
spec.upgrade.imagePullPolicy	IfNotPresent	Optional Specifies the pull policy for the container image. - Always - IfNotPresent - Never
spec.upgrade.source.pgAdminTls.certificateName		Optional If you do not define spec.fepChildCrVal.sysUsers.pgAdminTls.certificateName for the data source, it points to the Kubernetes TLS secret that contains the certificate for the Postgres user "postgres" in the data source. If the data source FEP has set the authentication method for the upgrade execution container to "cert", then the upgrade execution container uses the certificate defined as secret.
spec.upgrade.destination.pgAdminTls.certificateName		Optional If you have not defined the spec.fepChildCrVal.sysUsers.pgAdminTls.certificateName of the newly created FEPCluster, it points to the Kubernetes TLS secret that contains the certificate of the Postgres user "postgres" in the data source. If you create a new FEP with the "cert" authentication method for the upgrade execution container, the upgrade execution container uses the certificate defined as secret.
spec.upgrade.storage		Optional Defines the storage for storing dump files.
spec.upgrade.storage.storageClass		Optional If omitted, the default storage class for your environment is used.
spec.upgrade.storage.size	2Gi	Optional Specifies the size of the storage to store the dump file.
spec.upgrade.storage.accessModes	ReadWriteOnce	Optional accessModes for store the dump file Specified as an array of accessModes e.g. [ReadWriteMany] If omitted, it will be treated as [ReadWriteOnce]

1.2.14 FEPLogging Custom Resources

The `feplLogging` section needs to be added under `spec` to define required parameters for FEPLogging configuration.

Following is a sample template :

```
spec:
  feplLogging:
    elastic:
      authSecret:
        secretName: elastic-auth
        passwordKey: password
        userKey: username
      host: elastic-passthrough.apps.openshift.com
      logstashPrefix: postgres
      port: 443
      scheme: https
      sslVerify: true
      tls:
        certificateName: elastic-cert
        caName: elastic-cacert
    image:
      pullPolicy: IfNotPresent
    mcSpec:
      limits:
        cpu: 500m
        memory: 700Mi
      requests:
        cpu: 200m
        memory: 512Mi
      restartRequired: false
      sysExtraLogging: false
      scrapeInterval: 30s
      scrapeTimeout: 30s
      tls:
        certificateName: fluentd-cert
        caName: cacert
    prometheus:
      ...
```

Below is the list of all parameters defined in the `feplLogging` section, along with their brief description

Custom Resource spec	Required/Optional	Change Effect	Updating value allowed
<code>spec.feplLogging.image.image</code>	Optional	Fluentd Image of FEPLogging	Yes
<code>spec.feplLogging.image.pullPolicy</code>	Required	Fluentd Image pull policy of FEPLogging	Yes
<code>spec.feplLogging.mcSpec.limits.cpu</code>	Required	Max CPU allocated to fluentd container	Yes
<code>spec.feplLogging.mcSpec.limits.memory</code>	Required	Max memory allocated to fluentd container	Yes
<code>spec.feplLogging.mcSpec.requests.cpu</code>	Required	CPU allocation at start for fluentd container	Yes
<code>spec.feplLogging.mcSpec.requests.memory</code>	Required	Memory allocation at start for fluentd container	Yes
<code>spec.feplLogging.sysExtraLogging</code>	Required	To turn on extra debugging messages for operator, set value to true. It can be turned on/off at any time	Yes

Custom Resource spec	Required/ Optional	Change Effect	Updating value allowed
spec.fepLogging.sysExtraEvent	Optional	To turn on event notification for changes to custom resources, set the value to true. You can turn it on or off at any time.	Yes
spec.fepLogging.restartRequired	Required	To restart FEPLogging instance for applying any new configuration for example after certificate rotation	Yes
spec.fepLogging.scrapeInterval	Optional	Scrape interval for Prometheus to fetch metrics from FEPLogging instance	Yes
spec.fepLogging.scrapeTimeout	Optional	Scrape Timeout for Prometheus to fetch metrics from FEPLogging instance	Yes
spec.fepLogging.elastic.host	Optional	Target Elasticsearch host name	Yes
spec.fepLogging.elastic.port	Optional	Target Elasticsearch port number	Yes
spec.fepLogging.elastic.authSecret.secretName	Optional	Secret name which contains Elasticsearch authentication username & password	Yes
spec.fepLogging.elastic.authSecret.userNameKey	Optional	Username key specified in Elasticsearch authentication secret	Yes
spec.fepLogging.elastic.authSecret.passwordKey	Optional	Password key specified in Elasticsearch authentication secret	Yes
spec.fepLogging.elastic.logstashPrefix	Optional	Logstash prefix to differentiate index pattern in elastic search. Default value is postgres	Yes
spec.fepLogging.elastic.auditLogstashPrefix	Optional	Logstash prefix to differentiate index pattern in elastic search for auditlog. Default value is postgres	Yes
spec.fepLogging.elastic.scheme	Optional	Connection scheme between FEPLogging & Elasticsearch. Possible options http & https	Yes
spec.fepLogging.elastic.sslVerify	Optional	Set to true if you want to verify ssl certificate. If set to false then will not consider TLS certificate	Yes
spec.fepLogging.elastic.tls.certificateName	Optional	Kubernetes secret name which holds fluentd certificate	Yes
spec.fepLogging.elastic.tls.caName	Optional	Kubernetes configmap which holds cacert of Elasticsearch to verify Elasticsearch TLS connection	Yes
spec.fepLogging.tls.certificateName	Optional	Kubernetes secret name which holds Fluentd certificate	Yes
spec.fepLogging.tls.caName	Optional	Kubernetes configmap which holds cacert of Fluentd to configure MTLs between FEPLogging & Prometheus	Yes
spec.prometheus.tls.certificateName	Optional	Kubernetes secret name which holds Prometheus certificate	Yes
spec.prometheus.tls.caName	Optional	Kubernetes configmap which holds cacert of Fluentd to configure MTLs between FEPLogging & Prometheus	Yes

1.2.15 FEP Custom Resources - spec.fep.pgBadger

Custom Resource spec	Change Effect
pgBadger.schedules.create	The 'create' schedule to create report and upload it to endpoint
pgBadger.schedules.cleanup	The 'cleanup' schedule to delete the report left in container
pgBadger.options.incremental	Default: false; When set to true: create incremental report in pgbadger
pgBadger.endpoint.authentication	a secret to contain authentication info to access endpoint support basic auth only
pgBadger.endpoint.customCertificateName	Client certificate reference in customCertificate CR
pgBadger.endpoint.fileUploadParameter	The file upload parameter defined by the web server Default: 'file'
pgBadger.endpoint.insecure	equivalent to curl -insecure option, default to false
pgBadger.endpoint.url	Web server url to upload the report file

1.2.16 FEP Custom Resources - spec.fep.pgAuditLog

1.2.16.1 Details of pgAuditLog.endpoint.authentication

Protocol	Required key	Description
'http' or not defined	basic_auth	The basic authentication for http web server
's3'	aws_access_key	AWS access key
	aws_secret_key	AWS secret key
'blob'	azure_storage_account_name	Azure storage account name
	azure_storage_account_key	Azure storage account key

The Operator creates a default secret with keys for all the protocols with empty values when "pgAuditLog.endpoint.authentication" is not defined or empty.

The default secret is a template which the end user can update its proper values. The following is its content:

Default Authentication Secret
<pre> kind: Secret apiVersion: v1 metadata: name: [FEPCluster name]-pgauditlog-auth namespace: [FEPCluster namespace] type: Opaque data: basic_auth: "" aws_access_key: "" aws_access_secret: "" azure_storage_account_name: "" azure_storage_account_key: "" </pre>

When the default secret is created, the Operator also updates the created secret name in the FEPCluster CR:

FEPCluster
<pre>spec.fep pgAuditLog: enable: 'true' endpoint: protocol: 's3' authentication: '[FEPCluster name]-pgauditlog-auth' ...</pre>

The Operator uses the default secret but the upload feature will fail as the secret does not contain correct values. So the end user needs to update the values of the default secret to use upload feature properly.

 **Note**

- The Operator does not own - user specified secret because it is created by the end user. Only the default secret created by operator is owned by the cluster.
- When the FEPCluster has been delete, this secret will remain.

1.2.16.2 CR example for customized pgaudit ConfigMap

- Enable pgAudit
 - The pgAudit extension will be enabled.
- Use custom pgAudit config file
 - The pgAudit log will be output based on custom configuration

FEPCluster
<pre>spec.fep pgAuditLog: enable: 'true' config: my-pgaudit-conf endpoint: # fepChildCrVal.customPgAudit will be ignored in this case</pre>

ConfigMap - Name: my-pgaudit-conf
<pre>data: pgaudit.conf: [output] logger = 'auditlog' log_directory = '/database/log/audit' [rule] audit_role='jason' database='demo' class='READ, WRITE' [option]</pre>

1.2.16.3 CR example when uploading logs to Azure Blob

Use Azure blob as an endpoint to upload pgAudit file

FEPCluster (using Azue blob as endpoint)
<pre>spec.fep pgAuditLog: enable: 'true'</pre>

FEPCluster (using Azue blob as endpoint)
<pre> endpoint: protocol: 'blob' authentication: my-azure-blob-secret azureContainerName: cluster1 azureBlobName: pgaudit-log-1 schedules: upload: '30 * * * *'</pre>

Secret - Name: my-azure-blob-secret
<pre> data: azure_storage_account_name: cG9zdGdyZXM= azure_storage_account_key: ZnNcG9zdGads3cGzdGdyZXMyZXMlcA==</pre>

1.2.16.4 CR example for uploading logs to S3

Use AWS S3 as an endpoint to upload pgAudit file

- The pgAudit log will be uploaded to AWS s3 storage based on the provided schedule.

FEPCluster (using S3 as endpoint)
<pre> spec.fep pgAuditLog: enable: 'true' endpoint: url: 's3://pgaudit1/cluster1' protocol: 's3' authentication: my-aws-s3-secret schedules: upload: '30 * * * *'</pre>

Secret - Name: my-aws-s3-secret
<pre> data: aws_access_key: cG9zdGdyZXM= aws_access_secret: ZnNlcA3AZnNlcA3A==</pre>

Appendix A Default Metrics Queries

```
pg_capacity_connection:
  query: |
    select sys, idle, idleintx, idleintxl0min, idleintxlhour, idleintxlday, idleintxlweek,
    (curr.idle + curr.idleintx + curr.active) total, s.setting "max" from
    (
      select
        count(CASE WHEN a.state is null THEN 1 END) sys,
        count(CASE WHEN a.state='idle' THEN 1 END) idle,
        count(CASE WHEN a.state='idle in transaction' OR a.state='idle in transaction (aborted)' THEN
1 END) idleintx,
        count(CASE WHEN (a.state='idle in transaction' OR a.state='idle in transaction (aborted)') AND
age(now(), state_change) > interval '10 min' THEN 1 END) idleintxl0min,
        count(CASE WHEN (a.state='idle in transaction' OR a.state='idle in transaction (aborted)') AND
age(now(),state_change) > interval '1 hour' THEN 1 END) idleintxlhour,
        count(CASE WHEN (a.state='idle in transaction' OR a.state='idle in transaction (aborted)') AND
age(now(),state_change) > interval '1 day' THEN 1 END) idleintxlday,
        count(CASE WHEN (a.state='idle in transaction' OR a.state='idle in transaction (aborted)') AND
age(now(),state_change) > interval '1 week' THEN 1 END) idleintxlweek,
        count(CASE WHEN a.state='active' THEN 1 END) active
      from pg_stat_activity a
    ) curr, pg_settings s where name = 'max_connections'
  master: true
  metrics:
    - sys:
      usage: 'GAUGE'
      description: 'Number of system connections.'
    - idle:
      usage: 'GAUGE'
      description: 'Number of idle connections.'
    - idleintx:
      usage: 'GAUGE'
      description: 'Number of idle in transaction connections.'
    - idleintxl0min:
      usage: 'GAUGE'
      description: 'Number of idle in transaction connections running longer than 10 min.'
    - idleintxlhour:
      usage: 'GAUGE'
      description: 'Number of idle in transaction connections running longer than 1 hour.'
    - idleintxlday:
      usage: 'GAUGE'
      description: 'Number of idle in transaction connections running longer than 1 day.'
    - idleintxlweek:
      usage: 'GAUGE'
      description: 'Number of idle in transaction connections running longer than 1 week.'
    - total:
      usage: 'GAUGE'
      description: 'Number of total connections.'
    - max:
      usage: 'GAUGE'
      description: 'Max number of connections.'

pg_capacity_schema:
  query: |
    SELECT current_database() AS database_name, table_schema,
    COALESCE(SUM(pg_total_relation_size('' || table_schema || ''.''' || table_name || ''')), 0) AS size
    FROM information_schema.tables GROUP BY table_schema
  master: true
  metrics:
    - database_name:
      usage: 'LABEL'
```

```

        description: 'Database name.'
- table_schema:
    usage: 'LABEL'
    description: 'Table schema name.'
- size:
    usage: 'GAUGE'
    description: 'Disk space of schema.'

pg_capacity_tblspace:
query: |
    SELECT pg_tablespace.spcname AS tablespace_name, pg_tablespace_size(pg_tablespace.spcname) AS
tablespace_size FROM pg_tablespace
master: true
metrics:
- tablespace_name:
    usage: 'LABEL'
    description: 'Table space name.'
- tablespace_size:
    usage: 'GAUGE'
    description: 'Disk space of table space.'

pg_capacity_tblvacuum:
query: |
    SELECT current_database() datname, t.table_schema, count(t.table_name) table_count
    FROM information_schema.tables t
    INNER JOIN pg_catalog.pg_stat_user_tables tu on t.table_schema::text=tu.schemaname::text and
t.table_name::text=tu.relname::text
    and
    age(now(),greatest(COALESCE(last_vacuum, '1970-01-01Z'), COALESCE(last_autovacuum,
'1970-01-01Z'))) > interval '1 day'
    GROUP BY t.table_schema
master: true
metrics:
- datname:
    usage: 'LABEL'
    description: 'Database name.'
- table_schema:
    usage: 'LABEL'
    description: 'Table schema name.'
- table_count:
    usage: 'GAUGE'
    description: 'Number of tables without vacuum for more than a day.'

pg_capacity_longtx:
query: |
    with xact_count as (
    SELECT COALESCE(datname, '') datname, count(1)
    FROM pg_stat_activity
    where backend_type='client backend' and age(now(), COALESCE(xact_start, '1970-01-01Z')) >
interval '5 minutes'
    group by datname
    )
    select d.datname, coalesce(xc.count, 0) as count from pg_database d left join xact_count xc on
d.datname=xc.datname
master: true
metrics:
- datname:
    usage: 'LABEL'
    description: 'Database name.'
- count:
    usage: 'GAUGE'
    description: 'Number of transactions running longer than 5 minutes.'

```

```

pg_capacity_tblbloat:
query: |
    SELECT DISTINCT
        current_database() as datname, schemaname, tablename as relname, /*reltuples::bigint,
relpages::bigint, otta,*/
        CASE WHEN relpages < otta THEN 0 ELSE bs*(sml.relpages-otta)::BIGINT END AS wastedbytes
    FROM (
        SELECT
            schemaname, tablename, cc.reltuples, cc.relpages, bs,
            CEIL((cc.reltuples*((datahdr+ma-
                (CASE WHEN datahdr%ma=0 THEN ma ELSE datahdr%ma END))+nullhdr2+4))/(bs-20::float)) AS otta,
            COALESCE(c2.relname, '?') AS iname, COALESCE(c2.reltuples,0) AS ituples, COALESCE(c2.relpages,
0) AS ipages,
            COALESCE(CEIL((c2.reltuples*(datahdr-12))/(bs-20::float)),0) AS iotta -- very rough
approximation, assumes all cols

        FROM (
            SELECT
                ma,bs,schemaname,tablename,
                (datawidth+(hdr+ma-(case when hdr%ma=0 THEN ma ELSE hdr%ma END))):numeric AS datahdr,
                (maxfracsum*(nullhdr+ma-(case when nullhdr%ma=0 THEN ma ELSE nullhdr%ma END))) AS nullhdr2
            FROM (
                SELECT
                    schemaname, tablename, hdr, ma, bs,
                    SUM((1-null_frac)*avg_width) AS datawidth,
                    MAX(null_frac) AS maxfracsum,
                    hdr+(
                        SELECT 1+count(*)/8
                        FROM pg_stats s2
                        WHERE null_frac<>0 AND s2.schemaname = s.schemaname AND s2.tablename = s.tablename
                    ) AS nullhdr
                FROM pg_stats s, (
                    SELECT
                        (SELECT current_setting('block_size')::numeric) AS bs,
                        CASE WHEN substring(v,12,3) IN ('8.0','8.1','8.2') THEN 27 ELSE 23 END AS hdr,
                        CASE WHEN v ~ 'mingw32' THEN 8 ELSE 4 END AS ma
                    FROM (SELECT version() AS v) AS foo
                ) AS constants
                GROUP BY 1,2,3,4,5
            ) AS foo
        ) AS rs
        JOIN pg_class cc ON cc.relname = rs.tablename
        JOIN pg_namespace nn ON cc.relnamespace = nn.oid AND nn.nspname = rs.schemaname AND nn.nspname
<> 'information_schema'
        LEFT JOIN pg_index i ON indrelid = cc.oid
        LEFT JOIN pg_class c2 ON c2.oid = i.indexrelid
    ) AS sml
    ORDER BY wastedbytes DESC
master: true
metrics:
- datname:
    usage: 'LABEL'
    description: 'Database name.'
- schemaname:
    usage: 'LABEL'
    description: 'Schema name.'
- relname:
    usage: 'LABEL'
    description: 'Name of this table.'
- wastedbytes:
    usage: 'GAUGE'
    description: 'Number of bytes wasted for table.'

```


pg_performance_locking_detail:

```
query: |
    SELECT blocked_locks.pid AS blocked_pid,
           blocked_activity.username AS blocked_user,
           blocking_locks.pid AS blocking_pid,
           blocking_activity.username AS blocking_user,
           blocked_activity.query AS blocked_statement,
           1 locks
    FROM pg_catalog.pg_locks blocked_locks
    JOIN pg_catalog.pg_stat_activity blocked_activity ON blocked_activity.pid = blocked_locks.pid
    JOIN pg_catalog.pg_locks blocking_locks
    ON blocking_locks.locktype = blocked_locks.locktype
    AND blocking_locks.DATABASE IS NOT DISTINCT FROM blocked_locks.DATABASE
    AND blocking_locks.relation IS NOT DISTINCT FROM blocked_locks.relation
    AND blocking_locks.page IS NOT DISTINCT FROM blocked_locks.page
    AND blocking_locks.tuple IS NOT DISTINCT FROM blocked_locks.tuple
    AND blocking_locks.virtualxid IS NOT DISTINCT FROM blocked_locks.virtualxid
    AND blocking_locks.transactionid IS NOT DISTINCT FROM blocked_locks.transactionid
    AND blocking_locks.classid IS NOT DISTINCT FROM blocked_locks.classid
    AND blocking_locks.objid IS NOT DISTINCT FROM blocked_locks.objid
    AND blocking_locks.objsubid IS NOT DISTINCT FROM blocked_locks.objsubid
    AND blocking_locks.pid != blocked_locks.pid
    JOIN pg_catalog.pg_stat_activity blocking_activity ON blocking_activity.pid = blocking_locks.pid
    WHERE NOT blocked_locks.GRANTED
```

master: true

metrics:

- blocked_pid:
 - usage: 'LABEL'
 - description: 'Blocked process id.'
- blocked_user:
 - usage: 'LABEL'
 - description: 'Blocked user.'
- blocking_pid:
 - usage: 'LABEL'
 - description: 'Blocking process id.'
- blocking_user:
 - usage: 'LABEL'
 - description: 'Blocking user.'
- blocked_statement:
 - usage: 'LABEL'
 - description: 'Blocked statement.'
- locks:
 - usage: 'GAUGE'
 - description: 'Number of processes in blocked state.'

pg_performance_locking:

```
query: |
    WITH
    locks as (
        SELECT blocked_locks.DATABASE, count(blocked_locks.pid) locks
        FROM pg_catalog.pg_locks blocked_locks
        JOIN pg_catalog.pg_stat_activity blocked_activity ON blocked_activity.pid = blocked_locks.pid
        JOIN pg_catalog.pg_locks blocking_locks
        ON blocking_locks.locktype = blocked_locks.locktype
        AND blocking_locks.DATABASE IS NOT DISTINCT FROM blocked_locks.DATABASE
        AND blocking_locks.relation IS NOT DISTINCT FROM blocked_locks.relation
        AND blocking_locks.page IS NOT DISTINCT FROM blocked_locks.page
        AND blocking_locks.tuple IS NOT DISTINCT FROM blocked_locks.tuple
        AND blocking_locks.virtualxid IS NOT DISTINCT FROM blocked_locks.virtualxid
        AND blocking_locks.transactionid IS NOT DISTINCT FROM blocked_locks.transactionid
        AND blocking_locks.classid IS NOT DISTINCT FROM blocked_locks.classid
        AND blocking_locks.objid IS NOT DISTINCT FROM blocked_locks.objid
        AND blocking_locks.objsubid IS NOT DISTINCT FROM blocked_locks.objsubid
```

```

        AND blocking_locks.pid != blocked_locks.pid
        JOIN pg_catalog.pg_stat_activity blocking_activity ON blocking_activity.pid =
blocking_locks.pid
        WHERE NOT blocked_locks.GRANTED group by blocked_locks.DATABASE
    ),
    dbs as (
        select * from pg_catalog.pg_database
    )
    select dbs.datname, coalesce(locks.locks, 0) locks from dbs left join locks on dbs.oid=DATABASE
master: true
metrics:
  - datname:
      usage: 'LABEL'
      description: 'Database name'
  - locks:
      usage: 'GAUGE'
      description: 'Number of processes in blocked state.'

pg_replication:
  query: |
    SELECT CASE WHEN pg_last_wal_receive_lsn() = pg_last_wal_replay_lsn() THEN 0 ELSE GREATEST (0,
EXTRACT(EPOCH FROM (now() - pg_last_xact_replay_timestamp()))) END AS lag
  master: true
  metrics:
    - lag:
        usage: "GAUGE"
        description: "Replication lag behind master in seconds"

pg_postmaster:
  query: |

    SELECT pg_postmaster_start_time as start_time_seconds from pg_postmaster_start_time()
  master: true
  metrics:
    - start_time_seconds:
        usage: "GAUGE"
        description: "Time at which postmaster started"

pg_stat_user_tables:
  query: |
    SELECT
      current_database() datname,
      schemaname,
      relname,
      seq_scan,
      seq_tup_read,
      idx_scan,
      idx_tup_fetch,
      n_tup_ins,
      n_tup_upd,
      n_tup_del,
      n_tup_hot_upd,
      n_live_tup,
      n_dead_tup,
      n_mod_since_analyze,
      last_vacuum,
      last_autovacuum,
      last_analyze,
      last_autoanalyze,
      vacuum_count,
      autovacuum_count,
      analyze_count,
      autoanalyze_count

```

```

FROM
  pg_stat_user_tables
master: true
metrics:
  - datname:
      usage: "LABEL"
      description: "Name of current database"
  - schemaname:
      usage: "LABEL"
      description: "Name of the schema that this table is in"
  - relname:
      usage: "LABEL"
      description: "Name of this table"
  - seq_scan:
      usage: "COUNTER"
      description: "Number of sequential scans initiated on this table"
  - seq_tup_read:
      usage: "COUNTER"
      description: "Number of live rows fetched by sequential scans"
  - idx_scan:
      usage: "COUNTER"
      description: "Number of index scans initiated on this table"
  - idx_tup_fetch:
      usage: "COUNTER"
      description: "Number of live rows fetched by index scans"
  - n_tup_ins:
      usage: "COUNTER"
      description: "Number of rows inserted"
  - n_tup_upd:
      usage: "COUNTER"
      description: "Number of rows updated"
  - n_tup_del:
      usage: "COUNTER"
      description: "Number of rows deleted"
  - n_tup_hot_upd:
      usage: "COUNTER"
      description: "Number of rows HOT updated (i.e., with no separate index update required)"
  - n_live_tup:
      usage: "GAUGE"
      description: "Estimated number of live rows"
  - n_dead_tup:
      usage: "GAUGE"
      description: "Estimated number of dead rows"
  - n_mod_since_analyze:
      usage: "GAUGE"
      description: "Estimated number of rows changed since last analyze"
  - last_vacuum:
      usage: "GAUGE"
      description: "Last time at which this table was manually vacuumed (not counting VACUUM FULL)"
  - last_autovacuum:
      usage: "GAUGE"
      description: "Last time at which this table was vacuumed by the autovacuum daemon"
  - last_analyze:
      usage: "GAUGE"
      description: "Last time at which this table was manually analyzed"
  - last_autoanalyze:
      usage: "GAUGE"
      description: "Last time at which this table was analyzed by the autovacuum daemon"
  - vacuum_count:
      usage: "COUNTER"
      description: "Number of times this table has been manually vacuumed (not counting VACUUM
FULL)"
  - autovacuum_count:

```

```

        usage: "COUNTER"
        description: "Number of times this table has been vacuumed by the autovacuum daemon"
    - analyze_count:
        usage: "COUNTER"
        description: "Number of times this table has been manually analyzed"
    - autoanalyze_count:
        usage: "COUNTER"
        description: "Number of times this table has been analyzed by the autovacuum daemon"

pg_statio_user_tables:
    query: |
        SELECT current_database() datname, schemaname, relname, heap_blks_read, heap_blks_hit,
idx_blks_read, idx_blks_hit, toast_blks_read, toast_blks_hit, tidx_blks_read, tidx_blks_hit FROM
pg_statio_user_tables
    metrics:
    - datname:
        usage: "LABEL"
        description: "Name of current database"
    - schemaname:
        usage: "LABEL"
        description: "Name of the schema that this table is in"
    - relname:
        usage: "LABEL"
        description: "Name of this table"
    - heap_blks_read:
        usage: "COUNTER"
        description: "Number of disk blocks read from this table"
    - heap_blks_hit:
        usage: "COUNTER"
        description: "Number of buffer hits in this table"
    - idx_blks_read:
        usage: "COUNTER"
        description: "Number of disk blocks read from all indexes on this table"
    - idx_blks_hit:
        usage: "COUNTER"
        description: "Number of buffer hits in all indexes on this table"
    - toast_blks_read:
        usage: "COUNTER"
        description: "Number of disk blocks read from this table's TOAST table (if any)"
    - toast_blks_hit:
        usage: "COUNTER"
        description: "Number of buffer hits in this table's TOAST table (if any)"
    - tidx_blks_read:
        usage: "COUNTER"
        description: "Number of disk blocks read from this table's TOAST table indexes (if any)"
    - tidx_blks_hit:
        usage: "COUNTER"
        description: "Number of buffer hits in this table's TOAST table indexes (if any)"

pg_database:
    query: |

        SELECT pg_database.datname, pg_database_size(pg_database.datname) as size_bytes FROM pg_database
master: true
cache_seconds: 30
    metrics:
    - datname:
        usage: "LABEL"
        description: "Name of the database"
    - size_bytes:
        usage: "GAUGE"
        description: "Disk space used by the database"

```

```

pg_stat_statements:
  query: |
    SELECT t2.rolname, t3.datname, queryid, calls, total_plan_time / 1000 as
total_plan_time_seconds, total_exec_time / 1000 as total_exec_time_seconds, min_plan_time / 1000 as
min_plan_time_seconds, min_exec_time / 1000 as min_exec_time_seconds, max_plan_time / 1000 as
max_plan_time_seconds, max_exec_time / 1000 as max_exec_time_seconds, mean_plan_time / 1000 as
mean_plan_time_seconds, mean_exec_time / 1000 as mean_exec_time_seconds, stddev_plan_time / 1000 as
stddev_plan_time_seconds, stddev_exec_time / 1000 as stddev_exec_time_seconds, rows, shared_blks_hit,
shared_blks_read, shared_blks_dirtied, shared_blks_written, local_blks_hit, local_blks_read,
local_blks_dirtied, local_blks_written, temp_blks_read, temp_blks_written, blk_read_time / 1000 as
blk_read_time_seconds, blk_write_time / 1000 as blk_write_time_seconds FROM pg_stat_statements t1
JOIN pg_roles t2 ON (t1.userid=t2.oid) JOIN pg_database t3 ON (t1.dbid=t3.oid) WHERE t2.rolname !=
'rdsadmin'
  master: true
  metrics:
    - rolname:
      usage: "LABEL"
      description: "Name of user"
    - datname:
      usage: "LABEL"
      description: "Name of database"
    - queryid:
      usage: "LABEL"
      description: "Query ID"
    - calls:
      usage: "COUNTER"
      description: "Number of times executed"
    - total_plan_time_seconds:
      usage: "COUNTER"
      description: "Total plan time spent in the statement, in milliseconds"
    - total_exec_time_seconds:
      usage: "COUNTER"
      description: "Total exec time spent in the statement, in milliseconds"
    - min_plan_time_seconds:
      usage: "GAUGE"
      description: "Minimum plan time spent in the statement, in milliseconds"
    - min_exec_time_seconds:
      usage: "GAUGE"
      description: "Minimum exec time spent in the statement, in milliseconds"
    - max_plan_time_seconds:
      usage: "GAUGE"
      description: "Maximum plan time spent in the statement, in milliseconds"
    - max_exec_time_seconds:
      usage: "GAUGE"
      description: "Maximum exec time spent in the statement, in milliseconds"
    - mean_plan_time_seconds:
      usage: "GAUGE"
      description: "Mean plan time spent in the statement, in milliseconds"
    - mean_exec_time_seconds:
      usage: "GAUGE"
      description: "Mean exec time spent in the statement, in milliseconds"
    - stddev_plan_time_seconds:
      usage: "GAUGE"
      description: "Population standard deviation of plan time spent in the statement, in
milliseconds"
    - stddev_exec_time_seconds:
      usage: "GAUGE"
      description: "Population standard deviation of exec time spent in the statement, in
milliseconds"
    - rows:
      usage: "COUNTER"
      description: "Total number of rows retrieved or affected by the statement"
    - shared_blks_hit:

```

```

        usage: "COUNTER"
        description: "Total number of shared block cache hits by the statement"
- shared_blks_read:
        usage: "COUNTER"
        description: "Total number of shared blocks read by the statement"
- shared_blks_dirtied:
        usage: "COUNTER"
        description: "Total number of shared blocks dirtied by the statement"
- shared_blks_written:
        usage: "COUNTER"
        description: "Total number of shared blocks written by the statement"
- local_blks_hit:
        usage: "COUNTER"
        description: "Total number of local block cache hits by the statement"
- local_blks_read:
        usage: "COUNTER"
        description: "Total number of local blocks read by the statement"
- local_blks_dirtied:
        usage: "COUNTER"
        description: "Total number of local blocks dirtied by the statement"
- local_blks_written:
        usage: "COUNTER"
        description: "Total number of local blocks written by the statement"
- temp_blks_read:
        usage: "COUNTER"
        description: "Total number of temp blocks read by the statement"
- temp_blks_written:
        usage: "COUNTER"
        description: "Total number of temp blocks written by the statement"
- blk_read_time_seconds:
        usage: "COUNTER"
        description: "Total time the statement spent reading blocks, in milliseconds (if
track_io_timing is enabled, otherwise zero)"
- blk_write_time_seconds:
        usage: "COUNTER"
        description: "Total time the statement spent writing blocks, in milliseconds (if
track_io_timing is enabled, otherwise zero)"

```

```
pg_password_valid:
```

```

query: |
    SELECT
        rolname,
        TRUNC (EXTRACT (EPOCH FROM (rolvaliduntil - now())) / (60*60*24)) AS days,
        EXTRACT (EPOCH FROM (rolvaliduntil - now())) AS seconds,
        cast(rolvaliduntil AS TEXT) AS date
    FROM
        pg_roles
    WHERE
        rolvaliduntil!='infinity' AND rolvaliduntil is not null

```

```
master: true
```

```
metrics:
```

```

- rolname:
        usage: "LABEL"
        description: "Name of user"
- date:
        usage: "LABEL"
        description: "Password Expiration Date"
- days:
        usage: "GAUGE"
        description: "Number of days remaining before password expires."
- seconds:
        usage: "GAUGE"
        description: "Number of seconds remaining before password expires."

```

```

pg_not_set_password_valid:
query: |
SELECT
COUNT(CASE WHEN a.rolvaliduntil is null AND a.rolcanlogin='t' THEN 1 END) null_count,
COUNT(CASE WHEN a.rolvaliduntil='infinity' AND a.rolcanlogin='t' THEN 1 END) infinity_count,
COUNT(CASE WHEN (a.rolvaliduntil is null OR a.rolvaliduntil='infinity') AND a.rolcanlogin='t'
THEN 1 END) all_count
FROM pg_roles a
master: true
metrics:
- null_count:
usage: "GAUGE"
description: "Number of days remaining before password valid is null."
- infinity_count:
usage: "GAUGE"
description: "Number of days remaining before password valid is infinity."
- all_count:
usage: "GAUGE"
description: "Number of days remaining before password valid is null or infinity."

pg_tde_encrypted:
query: |
SELECT
current_database() datname,
ts.oid AS tablespace_oid,
ts.spcname AS tablespace_name,
tsx.spcencalgo AS encryption_algorithm,
coalesce(t.count, 0) AS objs
FROM
pg_tablespace ts
JOIN pgx_tablespaces tsx ON ts.oid = tsx.spctablespace
LEFT OUTER JOIN (
SELECT
CASE WHEN c.reltablespace <> 0
THEN c.reltablespace
ELSE (select dattablespace from pg_database where datname = current_database())
END AS reltablespaceid,
count(*) AS count
FROM pg_class c
LEFT JOIN pg_namespace n ON n.oid = c.relnamespace
WHERE c.relkind = ANY (ARRAY['r'::"char", 'm'::"char", 'p'::"char", 'i'::"char"])
AND (n.nspname <> ALL (ARRAY['pg_toast'::name, 'pg_catalog'::name,
'information_schema'::name]))
GROUP BY c.reltablespace
) t ON t.reltablespaceid = ts.oid
metrics:
- datname:
usage: 'LABEL'
description: "Database name."
- tablespace_oid:
usage: 'LABEL'
description: "oid of the tablespace to check."
- tablespace_name:
usage: 'LABEL'
description: "Name of the tablespace to check."
- encryption_algorithm:
usage: 'LABEL'
description: "Algorithm used for encryption."
- objs:
usage: 'GAUGE'
description: "Number of tables and indexes in the tablespace."

```

```

pg_user_profile:
  query: |
    SELECT
      COUNT(*) AS total_roles,
      SUM(CASE WHEN userprfpasswordstatus = 'o' AND userprfaccountlock = 0 THEN 1 ELSE 0 END) AS
valid_roles,
      SUM(CASE WHEN userprfpasswordstatus = 'g' AND userprfaccountlock = 0 THEN 1 ELSE 0 END) AS
grace_time_roles,
      SUM(CASE WHEN userprfpasswordstatus = 'e' AND userprfaccountlock = 0 THEN 1 ELSE 0 END) AS
expired_roles,
      SUM(CASE WHEN userprfpasswordstatus = 'o' AND userprfaccountlock IN (1, 2) THEN 1 ELSE 0 END)
AS locked_roles
    FROM pgx_user_profile;
  metrics:
    - total_roles:
      usage: "GAUGE"
      description: "number of roles"
    - valid_roles:
      usage: "GAUGE"
      description: "number of valid roles"
    - grace_time_roles:
      usage: "GAUGE"
      description: "number of grace time roles"
    - expired_roles:
      usage: "GAUGE"
      description: "number of expired roles"
    - locked_roles:
      usage: "GAUGE"
      description: "number of locked roles"

pg_txid:
  query: |
    SELECT max(age(datfrozenxid)) AS usage from pg_database where datallowconn = true
  metrics:
    - usage:
      usage: 'GAUGE'
      description: 'Cumulative number of transaction ID'

```


Appendix B Default Alert Rules

```
apiVersion: monitoring.coreos.com/v1
kind: PrometheusRule
metadata:
  name: {{ ansible_operator_meta.name }}-{{ item.name }}-alertrules
  namespace: {{ ansible_operator_meta.namespace }}
  labels:
    app: prometheus-postgres-exporter-alertrules
    name: {{ ansible_operator_meta.name }}-{{ item.name }}-alertrules
spec:
  groups:
    - name: fep-container
      rules:
        - alert: ContainerDisappeared
          annotations:
            description: {{ 'Container {{$labels.container}}/{{$labels.pod}} from
            {{$labels.namespace}} has been disappeared' }}
            summary: Container Pod disappeared.
          expr: time() -
            container_last_seen{ container="fep-patroni",
            namespace="{{ ansible_operator_meta.namespace }}", pod=~"^{item.name}-sts-.*" } > 60
          labels:
            severity: warning
        - alert: ContainerHighCPUUsage
          annotations:
            description: {{ 'Container {{$labels.container}}/{{$labels.pod}} from
            {{$labels.namespace}} has been high on CPU usage(>80%) for 5 mins' }}
            summary: High Container CPU usage.
          expr:
            (sum(node_namespace_pod_container:container_cpu_usage_seconds_total:sum_rate{pod=~"{{ item.name }}-
            sts.*", namespace="{{ ansible_operator_meta.namespace }}", container="fep-patroni"}) by
            (pod,namespace,container)/sum(kube_pod_container_resource_limits_cpu_cores) by
            (pod,namespace,container))*100 > 80
          for: 5m
          labels:
            severity: warning
        - alert: ContainerHighRAMUsage
          annotations:
            description: {{ 'Container {{$labels.container}}/{{$labels.pod}} from
            {{$labels.namespace}} has been high on RAM usage(>80%) since 30 mins' }}
            summary: High container memory usage.
          expr: sum(container_memory_working_set_bytes{pod=~"{{ item.name }}-sts.*",
            namespace="{{ ansible_operator_meta.namespace }}", container="fep-patroni" } /
            container_spec_memory_limit_bytes * 100) by (pod, container, instance) > 80
          for: 30m
          labels:
            severity: warning
        - alert: PVCLowDiskSpace
          annotations:
            description: {{ 'Found low disk space on {{$labels.persistentvolumeclaim}} in
            {{$labels.namespace}} namespace.' }}
            summary: {{ 'Found low disk space on {{$labels.persistentvolumeclaim}} in
            {{$labels.namespace}} namespace.' }}
          expr:
            kubelet_volume_stats_available_bytes{namespace="{{ ansible_operator_meta.namespace }}",
            persistentvolumeclaim=~"fep.*{item.name}.*"} / (kubelet_volume_stats_capacity_bytes) * 100 < 10
          for: 5m
          labels:
            severity: warning
    - name: postgres
      rules:
```

```

- alert: PostgresqlDown
  annotations:
    description: "Postgresql one or more instances are down in FEPCluster {{ item.name }} in
  namespace. Please check the FEP pods in this cluster"
    summary: "Postgresql FEPCluster {{ item.name }} in namespace is degraded"
    expr: count(pg_static{ namespace="{{ ansible_operator_meta.namespace }}",
  service="{{ ansible_operator_meta.name }}-service", server=~"{{item.name}}-sts.*" }) <
  {{item.instances | length}}
    labels:
      severity: error
- alert: PostgresqlTooManyConnections
  annotations:
    description: {{ 'PostgreSQL instance has too many connections on server
  {{ $labels.server }} in {{ $labels.namespace }} namespace.' }}
    summary: {{ 'Postgresql too many connections (FEPCluster server {{ $labels.server }})' }}
    expr: pg_capacity_connection_total{namespace="{{ ansible_operator_meta.namespace }}",
  service="{{ ansible_operator_meta.name }}-service", server=~"{{ item.name }}-sts.*"}/
  pg_settings_max_connections > 0.9
    labels:
      severity: warning
- alert: PostgresqlRolePasswordCloseExpierd
  annotations:
    description: "The Postgresql role's password expires in less than 7 days. Please update
  the password."
    summary: "Postgresql Role Password expires in less than 7 days."
    expr: count(pg_password_valid_days{ namespace="{{ ansible_operator_meta.namespace }}",
  service="{{ ansible_operator_meta.name }}-service", server=~"{{ item.name }}-sts.*", rolname=~".*"
  < 8) > 0
    labels:
      severity: warning
- alert: PostgresqlRolePasswordExpired
  annotations:
    description: "The Postgresql role's password has already expired. Please update the
  password."
    summary: "Postgresql Role Password has already expired. "
    expr: count(pg_password_valid_seconds{ namespace="{{ ansible_operator_meta.namespace }}",
  service="{{ ansible_operator_meta.name }}-service", server=~"{{ item.name }}-sts.*", rolname=~".*"
  < 0) > 0
    labels:
      severity: warning
- alert: PasswordIsGraceTimeByUserProfile
  annotations:
    description: The password for the role in the grace time exists. Please change your password.
    summary: There is a password in the grace time
    expr: grace_time_roles{ namespace="{{ ansible_operator_meta.namespace }}",
  service="{{ ansible_operator_meta.name }}-service", server=~"{{ item.name }}-sts.*" } > 0
    labels:
      severity: warning
- alert: PasswordExpiredByUserProfile
  annotations:
    description: Expired role password exists. Please change your password.
    summary: Expired role password exists
    expr: expired_roles{ namespace="{{ ansible_operator_meta.namespace }}",
  service="{{ ansible_operator_meta.name }}-service", server=~"{{ item.name }}-sts.*" } > 0
    labels:
      severity: warning
- alert: PasswordLockedByUserProfile
  annotations:
    description: There is a role with a password lock. Please confirm the role.
    summary: Password locked role exists
    expr: locked_roles{ namespace="{{ ansible_operator_meta.namespace }}",
  service="{{ ansible_operator_meta.name }}-service", server=~"{{ item.name }}-sts.*" } > 0

```

```
    labels:
      severity: warning
- alert: PostgreSQLTooManyTxidUsage
  annotations:
    description: "Transaction ID usage has exceeded the value of autovacuum_freeze_max_age for
more than 24 hours. Consider periodic aggressive vacuuming."
    summary: "Transaction ID usage exceeds autovacuum_freeze_max_age"
    expr: pg_txid_usage{ namespace="{{ ansible_operator_meta.namespace }}",
service="{{ ansible_operator_meta.name }}-service", server=~"{{ item.name }}-sts.*" } >
pg_settings_autovacuum_freeze_max_age
for: 24h
    labels:
      severity: warning
```

Appendix C Operator Operation Event Notification

C.1 FEPCluster Event Notification on Custom Resource Changes

When "spec.fep.sysExtraEvent" is true, event notification of operator actions occurs when you change the value of the following fields defined in the FEPCluster custom resource.

Field Whose Value You Want to Change	Notification Timing	Notification Custom Resources	Notification Message
spec.fep.image.image	Start Change	FEPCluster	Started patching fep-patroni spec.fep.image.image
	Change Successful	FEPCluster	Successfully patching fep-patroni spec.fep.image.image
	Change Failed	FEPCluster	Error/Failure in patching fep-patroni spec.fep.image.image
	FEPAcrion Successfully Inherits Action to Custom Resource	FEPCluster	Successfully creating FEPAcrionCR for restart so check FEPAcrion result
	Fail to inherit processing to FEPAcrion custom resource	FEPCluster	Error/Failure in creating FEPAcrionCR for restart
	Start Reflection	FEPAcrion	Started restart Action for ALL Pods
	reflection success	FEPAcrion	Successfully Restart Action for ALL Pods
	Reflection failed	FEPAcrion	Error/Failure Restart Action for ALL Pods
spec.fep.mcSpec	Start Change	FEPCluster	Started patching fep-patroni spec.fep.mcSpec
	Change Successful	FEPCluster	Successfully patching fep-patroni spec.fep.mcSpec
	Change Failed	FEPCluster	Error/Failure in patching fep-patroni spec.fep.mcSpec
	FEPAcrion Successfully Inherits Action to Custom Resource	FEPCluster	Successfully creating FEPAcrionCR for restart so check FEPAcrion result
	Fail to inherit processing to FEPAcrion custom resource	FEPCluster	Error/Failure in creating FEPAcrionCR for restart
	Start Reflection	FEPAcrion	Started restart Action for ALL Pods
	1.2.14reflection success	FEPAcrion	Successfully Restart Action for ALL Pods
	Reflection failed	FEPAcrion	Error/Failure Restart Action for ALL Pods
spec.fep.instances (Scale in)	Start Change	FEPCluster	Started scale in FEP Cluster
	Change Successful	FEPCluster	Successfully scale in FEP Cluster
	Change Failed	FEPCluster	Error/Failure in scale in FEP Cluster
spec.fep.instances (Scale out)	Start Change	FEPCluster	Started scale out FEP Cluster
	Change Successful	FEPCluster	Successfully scale out FEP Cluster

Field Whose Value You Want to Change	Notification Timing	Notification Custom Resources	Notification Message
	Change Failed	FEPCluster	Error/Failure in scale out FEP Cluster
spec.fep.pgBadger	Start Change	FEPCluster	Started update FEPCluster CR
	Succeeded in inheriting processing to FEPCluster custom resource	FEPCluster	Successfully updateing FEPCluster CR with current values
	Fail to inherit processing to FEPCluster custom resource	FEPCluster	Error/Failure in updateing FEPCluster CR with current values
	Start Reflection	FEPCluster	Started patching spec.fep.pgBadger
	reflection success	FEPCluster	Successfully patching spec.fep.pgAuditLog and spec.fep.pgBadger
	Reflection failed	FEPCluster	Error/Failure in patching spec.fep.pgAuditLog and spec.fep.pgBadger
spec.fep.pgBadger.schedule.create	reflection success	FEPCluster	Successfully updating spec.fep.pgBadger.schedules.create
	Reflection failed	FEPCluster	Error/Failure in updating spec.fep.pgBadger.schedules.create
spec.fep.pgBadger.schedule.cleanup	reflection success	FEPCluster	Successfully updating spec.fep.pgBadger.schedules.cleanup
	Reflection failed	FEPCluster	Error/Failure in updating spec.fep.pgBadger.schedules.cleanup
spec.fep.replicationSlots	Start Change	FEPCluster	Started update FEPCluster CR
	Succeeded in inheriting processing to FEPCluster custom resource	FEPCluster	Successfully updateing FEPCluster CR with current values
	Fail to inherit processing to FEPCluster custom resource	FEPCluster	Error/Failure in updateing FEPCluster CR with current values
	Start Reflection	FEPCluster	Started patching spec.fepChildCrVal.replicationSlots
	reflection success	FEPCluster	Successfully patching spec.fepChildCrVal.replicationSlots
	Reflection failed	FEPCluster	Error/Failure in patching spec.fepChildCrVal.replicationSlots
spec.fep.pgAuditLog	Start Change	FEPCluster	Started update FEPCluster CR
	Succeeded in inheriting processing to FEPCluster custom resource	FEPCluster	Successfully updateing FEPCluster CR with current values

Field Whose Value You Want to Change	Notification Timing	Notification Custom Resources	Notification Message
spec.fep.pgAuditLog	Fail to inherit processing to FEPCconfig custom resource	FEPCluster	Error/Failure in updateing FEPCconfig CR with current values
	Start Reflection	FEPCconfig	Started patching spec.fep.pgAuditLog
	reflection success	FEPCconfig	Successfully patching spec.fep.pgAuditLog and spec.fep.pgBadger
	Reflection failed	FEPCconfig	Error/Failure in patching spec.fep.pgAuditLog and spec.fep.pgBadger
spec.fep.pgAuditLog.auditLogPath	Start Reflection	FEPCconfig	Started patching spec.fep.pgAuditLog
	reflection success	FEPCconfig	Successfully patching spec.fep.pgAuditLog
	Reflection failed	FEPCconfig	Error/Failure in patching spec.fep.pgAuditLog
spec.fepChildCrVal.customPgAudit	Start Change	FEPCluster	Started update FEPCconfig CR
	Succeeded in inheriting processing to FEPCconfig custom resource	FEPCluster	Successfully updateing FEPCconfig CR with current values
	Fail to inherit processing to FEPCconfig custom resource	FEPCluster	Error/Failure in updateing FEPCconfig CR with current values
	Start Reflection	FEPCconfig	Started patching spec.fepChildCrVal.customPgAudit
	reflection success	FEPCconfig	Successfully patching spec.fepChildCrVal.customPgAudit so restart DB
	Reflection failed	FEPCconfig	Error/Failure in patching fepStatus to patch spec.fepChildCrVal.customPgAudit
spec.fepChildCrVal.customPgHba	Start Change	FEPCluster	Started update FEPCconfig CR
	Succeeded in inheriting processing to FEPCconfig custom resource	FEPCluster	Successfully updateing FEPCconfig CR with current values
	Fail to inherit processing to FEPCconfig custom resource	FEPCluster	Error/Failure in updateing FEPCconfig CR with current values
	Start Reflection	FEPCconfig	Started patching spec.fepChildCrVal.customPgHba
	reflection success	FEPCconfig	Successfully patching spec.fepChildCrVal.customPgHba
	Reflection failed	FEPCconfig	Error/Failure in patching spec.fepChildCrVal.customPgHba
spec.fepChildCrVal.customPgParams	Start Change	FEPCluster	Started update FEPCconfig CR

Field Whose Value You Want to Change	Notification Timing	Notification Custom Resources	Notification Message
	Succeeded in inheriting processing to FEPCConfig custom resource	FEPCluster	Successfully updateing FEPCConfig CR with current values
	Fail to inherit processing to FEPCConfig custom resource	FEPCluster	Error/Failure in updateing FEPCConfig CR with current values
	Start Reflection	FEPCConfig	Started patching spec.fepChildCrVal.customPgParams
	reflection success	FEPCConfig	Successfully patching spec.fepChildCrVal.customPgParams
	Reflection failed	FEPCConfig	Error/Failure in patching spec.fepChildCrVal.customPgParams
spec.fepChildCrVal.backup.image	Start Change	FEPCluster	Started patching spec.fepChildCrVal.backup.image
	Change Successful	FEPCluster	Successfully patching febackup spec.fepChildCrVal.backup.image
	Change Failed	FEPCluster	Error/Failure in patching febackup spec.fepChildCrVal.backup.image
spec.fepChildCrVal.backup.mcSpec	Start Change	FEPCluster	Started patching febackup spec.fepChildCrVal.backup.mcSpec
	Change Successful	FEPCluster	Successfully patching febackup spec.fepChildCrVal.backup.mcSpec
	Change Failed	FEPCluster	Error/Failure in patching febackup spec.fepChildCrVal.backup.mcSpec
spec.fepChildCrVal.backup.schedule.num	Start Change	FEPCluster	Started patching spec.fepChildCrVal.backup.schedule.num
	Change Successful	FEPCluster	Successfully patching spec.fepChildCrVal.backup
	Change Failed	FEPCluster	Error/Failure in patching spec.fepChildCrVal.backup
spec.fepChildCrVal.backup.pgbackrestKeyParams	Start Change	FEPCluster	Started patching spec.fepChildCrVal.backup.pgbackrestKeyParams
	Change Successful	FEPCluster	Successfully patching spec.fepChildCrVal.backup
	Change Failed	FEPCluster	Error/Failure in patching spec.fepChildCrVal.backup
spec.fepChildCrVal.backup.pgbackrestParams	Start Change	FEPCluster	Started patching spec.fepChildCrVal.backup.pgbackrestParams
	Change Successful	FEPCluster	Successfully patching spec.fepChildCrVal.backup
	Change Failed	FEPCluster	Error/Failure in patching spec.fepChildCrVal.backup
spec.fepChildCrVal.backup.schedule1	Start Change	FEPCluster	Started patching spec.fepChildCrVal.backup.schedule1

Field Whose Value You Want to Change	Notification Timing	Notification Custom Resources	Notification Message
	Change Successful	FEPCluster	Successfully patching spec.fepChildCrVal.backup.schedule1
	Change Failed	FEPCluster	Error/Failure in patching spec.fepChildCrVal.backup.schedule1
spec.fepChildCrVal.backup.schedule2	Start Change	FEPCluster	Started patching spec.fepChildCrVal.backup.schedule2
	Change Successful	FEPCluster	Successfully patching spec.fepChildCrVal.backup.schedule2
	Change Failed	FEPCluster	Error/Failure in patching spec.fepChildCrVal.backup.schedule2
spec.fepChildCrVal.backup.schedule3	Start Change	FEPCluster	Started patching spec.fepChildCrVal.backup.schedule3
	Change Successful	FEPCluster	Successfully patching spec.fepChildCrVal.backup.schedule3
	Change Failed	FEPCluster	Error/Failure in patching spec.fepChildCrVal.backup.schedule3
spec.fepChildCrVal.backup.schedule4	Start Change	FEPCluster	Started patching spec.fepChildCrVal.backup.schedule4
	Change Successful	FEPCluster	Successfully patching spec.fepChildCrVal.backup.schedule4
	Change Failed	FEPCluster	Error/Failure in patching spec.fepChildCrVal.backup.schedule4
spec.fepChildCrVal.backup.schedule5	Start Change	FEPCluster	Started patching spec.fepChildCrVal.backup.schedule5
	Change Successful	FEPCluster	Successfully patching spec.fepChildCrVal.backup.schedule5
	Change Failed	FEPCluster	Error/Failure in patching spec.fepChildCrVal.backup.schedule5
spec.fepChildCrVal.autoscale	Start Change	FEPCluster	Started patching spec.fepChildCrVal.autoscale
	Change Successful	FEPCluster	Successfully patching spec.fepChildCrVal.autoscale
	Change Failed	FEPCluster	Error/Failure in patching spec.fepChildCrVal.autoscale
spec.fepChildCrVal.storage	Start Change	FEPCluster	Started patching FEPVolume CR
	Change Successful	FEPCluster	Successfully patching FEPVolume CR with current values
	Change Failed	FEPCluster	Error/Failure in patching FEPVolume CR with current values
spec.fepChildCrVal.sysUsers	Start Change	FEPCluster	Started patching spec.fepChildCrVal.sysUsers passwords
	Change Successful	FEPCluster	Successfully patching spec.fepChildCrVal.sysUsers in FEPCluster
	Change Failed	FEPCluster	Error/Failure in patching spec.fepChildCrVal.sysUsers in FEPCluster

Field Whose Value You Want to Change	Notification Timing	Notification Custom Resources	Notification Message
spec.fepChildCrVal.sysUsers.pgMetricsPassword	Start Change	FEPCluster	Started setting spec.fepChildCrVal.sysUsers.pgMetricsPassword to FEPCluster where spec.fepChildCrVal.sysUsers.pgMetricsPassword is undefined
	Change Successful	FEPCluster	Successfully setting spec.fepChildCrVal.sysUsers.pgMetricsPassword
	Change Failed	FEPCluster	Error/Failure in Setting spec.fepChildCrVal.sysUsers.pgMetricsPassword
spec.fepChildCrVal.sysUsers.pgMetricsUserTls	Start Change	FEPCluster	Started setting spec.fepChildCrVal.sysUsers.pgMetricsUserTls to FEPCluster where spec.fepChildCrVal.sysUsers.pgMetricsUserTls is undefined
	Change Successful	FEPCluster	Successfully setting spec.fepChildCrVal.sysUsers.pgMetricsUserTls
	Change Failed	FEPCluster	Error/Failure in setting spec.fepChildCrVal.sysUsers.pgMetricsUserTls
spec.fepChildCrVal.sysUsers.pgMetricsUser	Start Change	FEPCluster	Started delete spec.fepChildCrVal.sysUsers.pgMetricsUser
	Change Successful	FEPCluster	Successfully setting spec.fepChildCrVal.sysUsers.pgMetricsUser or spec.fepChildCrVal.sysUsers.pgMetricsUserTls
	Change Failed	FEPCluster	Error/Failure in setting spec.fepChildCrVal.sysUsers.pgMetricsUser or spec.fepChildCrVal.sysUsers.pgMetricsUserTls
spec.fepChildCrVal.sysUsers.pgMetricsUserTls	Start Change	FEPCluster	Started delete spec.fepChildCrVal.sysUsers.pgMetricsUserTls
spec.fepChildCrVal.sysUsers.pgMetricsUserTls	Start Change	FEPCluster	Successfully setting spec.fepChildCrVal.sysUsers.pgMetricsUser or spec.fepChildCrVal.sysUsers.pgMetricsUserTls
	Change Successful	FEPCluster	Error/Failure in setting spec.fepChildCrVal.sysUsers.pgMetricsUser or spec.fepChildCrVal.sysUsers.pgMetricsUserTls
spec.sysTde.tdek.targetKeyId	Change Failed	FEPCluster	Started patching spec.sysTde.tdek.targetKeyId
	Start Change	FEPCluster	Successfully patching spec.sysTde.tdek.targetKeyId
	Change Successful	FEPCluster	Error/Failure in patching spec.sysTde.tdek.targetKeyId
spec.sysTde.tdek.kmsDefinition.sslpassphrase	Change Failed	FEPCluster	Started patching spec.sysTde.tdek.kmsDefinition.sslpassphrase
	Start Change	FEPCluster	Successfully patching spec.sysTde.tdek.kmsDefinition.sslpassphrase
	Change Successful	FEPCluster	Error/Failure in patching spec.sysTde.tdek.kmsDefinition.sslpassphrase

Field Whose Value You Want to Change	Notification Timing	Notification Custom Resources	Notification Message
spec.remoteLogging.image	Change Failed	FEPCluster	Started patching fep-logging-fluent-bit spec.remoteLogging.image
	Start Change	FEPCluster	Successfully patching fep-logging-fluent-bit spec.remoteLogging.image
	Change Successful	FEPCluster	Error/Failure in patching patching fep-logging-fluent-bit spec.remoteLogging
spec.monitoring.fepExporter.authSecret (new)	Change Failed	FEPCluster	Started patching FEPEXporter CR because spec.fepExporter.authSecret or spec.fepExporter.tls details are newly defined
	Start Change	FEPCluster	Successfully patching FEPEXporter CR for spec.fepExporter.authSecret or spec.fepExporter.tls details
	Start Change	FEPCluster	Error/Failure in patching FEPEXporter CR for spec.fepExporter.authSecret or spec.fepExporter.tls details
spec.monitoring.fepExporter.tls (new)	Change Successful	FEPCluster	Started patching FEPEXporter CR because spec.fepExporter.authSecret or spec.fepExporter.tls details are newly defined
	Change Failed	FEPCluster	Successfully patching FEPEXporter CR for spec.fepExporter.authSecret or spec.fepExporter.tls details
spec.monitoring.fepExporter.tls (new)	Change Failed	FEPCluster	Error/Failure in patching FEPEXporter CR for spec.fepExporter.authSecret or spec.fepExporter.tls details
spec.monitoring.fepExporter.authSecret (removed)	Start Change	FEPCluster	Started patching FEPEXporter CR because spec.fepExporter.authSecret details are deleted
	Change Successful	FEPCluster	Successfully patching spec.fepExporter.authSecret
	Change Failed	FEPCluster	Error/Failure in patching spec.fepExporter.authSecret
spec.monitoring.fepExporter.tls (removed)	Start Change	FEPCluster	Started patching FEPEXporter CR because spec.fepExporter.tls details are deleted
	Change Successful	FEPCluster	Successfully patching spec.fepExporter.tls
	Change Failed	FEPCluster	Error/Failure in patching spec.fepExporter.tls
spec.monitoring.fepExporter	Start Change	FEPCluster	Started creating FEPEXporter CR
	Change Successful	FEPCluster	Successfully creating FEPEXporter CR
	Change Failed	FEPCluster	Error/Failure in Creating FEPEXporter CR

C.2 FEPEXporter Event Notification on Custom Resource Changes

When "spec.fepExporter.sysExtraEvent" is true, provides event notification of operator actions when the value of the following fields defined in the FEPEXporter custom resource are changed.

Field Whose Value You Want to Change	Notification Timing	Notification Custom Resources	Notification Message
spec.fepExporter.restartRequired	Start Change	FEPExporter	Started patching spec.fepExporter.restartRequired
	Change Successful	FEPExporter	Successfully patching spec.fepExporter.restartRequired
	Change Failed	FEPExporter	Error/Failure in patching spec.fepExporter.restartRequired
spec.fepExporter.userCustomQueries	Start Change	FEPExporter	Started patching spec.fepExporter.userCustomQueries
	Change Successful	FEPExporter	Successfully patching spec.fepExporter.userCustomQueries
	Change Failed	FEPExporter	Error/Failure in patching spec.fepExporter.userCustomQueries

C.3 Event Notification When FEPLogging Custom Resource Changes

When "spec.fepLogging.sysExtraEvent" is true, provides event notification of operator actions when you change the value of the following fields defined in the FEPLogging custom resource.

Field Whose Value You Want to Change	Notification Timing	Notification Custom Resources	Notification Message
spec.fepLogging.restartRequired	Start Change	FEPLogging	Started patching spec.fepLogging.restartRequired
spec.fepLogging.restartRequired	Change Successful	FEPLogging	Successfully patching spec.fepLogging.restartRequired
spec.fepLogging.restartRequired	Change Failed	FEPLogging	Error/Failure in patching spec.fepLogging.restartRequired
spec.fepLogging.scrapeInterval spec.fepLogging.scrapeTimeout	Start Change	FEPLogging	Started patching spec.fepLogging.scrapeInterval and spec.fepLogging.scrapeTimeout
spec.fepLogging.scrapeInterval spec.fepLogging.scrapeTimeout	Change Successful	FEPLogging	Successfully patching spec.fepLogging.scrapeInterval and spec.fepLogging.scrapeTimeout
spec.fepLogging.scrapeInterval spec.fepLogging.scrapeTimeout	Change Failed	FEPLogging	Error/Failure in patching spec.fepLogging.scrapeInterval and spec.fepLogging.scrapeTimeout
spec.fepLogging.restartRequired	Start Change	FEPLogging	Started patching spec.fepLogging.restartRequired